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ABSTRACT

This study examines the current use of manufactured relocatable (portable) classrooms in the public school districts of Florida to determine whether their use is a cost efficient and educationally effective and safe means of handling short-term accommodation needs. Areas of research include: economic impacts; the physical classroom environment; facility planning; construction methodology; and impacts on existing facilities. The study contains questionnaire data received from 57 school districts and 900 teachers; 23 relocatable site visits throughout Florida; manufacturing site visits; and results from meetings with principles, teachers, contractors, and industry representatives. The study concludes with answers to the questions posed in the RFA from the Florida Department of Education Office of Educational Facilities along with recommendations concerning the design and planning of future relocatable classroom facilities. Appendices provide sample questionnaires, the site visit survey, results of the teacher's questionnaire, and life cycle cost analysis. (GR)

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The Use of Relocatable Classrooms in the Public School Districts of Florida

A Research Report for the
Florida Department of Education
Office of Educational Facilities

by

The Florida Center for Community Design + Research
University of South Florida
Tampa Florida

November 16, 1993

EF 005 742

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The Use of Relocatable Classrooms in the Public School Districts of Florida

A Research Report of the Florida Department of Education,
Office of Educational Facilities

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ABSTRACT

This comprehensive study examines the current use of manufactured relocatable (portable) classrooms in the public school districts of Florida to determine whether their use is indeed a cost efficient and educationally effective and safe means of handling short-term accommodation needs. Areas of research include: economic impacts, the physical classroom environment, facility planning, construction methodology, and impacts on existing facilities. Methods of investigation included: literature searches; questionnaires sent to superintendents and facility planners in the 67 public school districts (57 districts responded); questionnaires sent to 1,300 teachers within the 67 districts (900 teachers responded); site visits of relocatables at 23 schools throughout the state; site visits to manufacturing plants, meetings with principles, teachers, contractors, and industry representatives; reviews of construction documents; and a financial analysis. The study concludes with answers to the questions posed in the RFA from the Florida Department of Education Office of Educational Facilities along with recommendations concerning the design and planning of future relocatable classroom facilities.

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CHAPTER 1

Introduction

During the past twelve years (1981-1993) the state of Florida experienced explosive growth in public school enrollments, with average annual increases as high as 4.2%. School districts with ample classroom space for their students are the exception; the majority are hard pressed to provide enough classroom space to adequately house the number of new students in their districts. This trend is expected to continue over the foreseeable future according to Florida Department of Education forecasts. Total statewide enrollments through fiscal year 2000-01 are expected to rise at an average annual rate of slightly over 3.0%.

Compounding the difficulties of coping with explosive aggregate growth is the continuing problem of accurately forecasting intra-district enrollment patterns. There are numerous factors determining natural population increases, intra-district population movements and inter-regional growth patterns which make it hard or even impossible to accurately model and predict student enrollments. Geographic variations in growth, as much as anything, are contributing heavily to district-level problems in adequately housing local students.

Further exacerbating the current planning problem is the fact that the growth in funding for new capital improvement projects has been dwindling in recent years due to slower growth in district tax bases and effective caps on school fund millage rates. Furthermore, declining state funding sources, such as the Public Education Capital Outlay and Debt Service, and increased constituency reluctance to pass new school bond issues leaves school planners little resources to fight these problems. This trend is expected to

continue as Amendment 10 limits the growth of annual increases in residential property assessments, caps in school district millage rates remain at current levels, and state funds remain scarce. The increased use of residential impact fees for public school facilities may provide some additional funding for needed capital improvements, but certainly will not mitigate the existing and future shortfalls to any appreciable extent.

In recent years many Florida school districts have used manufactured relocatable or modular classrooms to temporarily solve their student housing problems. For many district officials the use of portable classrooms is considered a relatively inexpensive and expeditious means of meeting enrollment needs. Relocatables can be installed in 60 to 90 days, whereas the construction of a permanent classroom addition usually takes 6-18 months. Moreover, the mobility of these units helps school districts deal with unforeseen enrollment shifts as an existing relocatable can be quickly moved to fill short-term accommodation needs.

A major disadvantage of this type of educational facility is negative public perception. Some taxpayers criticize public fundings of what they consider substandard accommodations. The isolation of these temporary (sometimes permanent) facilities from both the parent school and other relocatables fragments the educational purposes of the school in the minds of the taxpayers. The lack of aesthetic design and visual incompatibility with the existing school gives some parents the impression their children are being taught in a less than optimum learning environment. The parents also worry about the safety of their children in these facilities. Furthermore, communities often resist these structures because their negative aesthetic impact on their surroundings.

However, the State has allowed taxpayer dollars to be used for the purchase of these structures with the promise that this was the most expedient and cost effective way

to solve the problem for short-term housing. However, there has never been a comprehensive study of the relocatable classroom to test the logic of their use, to evaluate their economic impact, or the feasibility of continuing the policy of providing classroom space with relocatable units (Florida Department of Education, 1992).

The State of Florida, Department of Education, Office of Educational Facilities in response to the Commissioner of Education, 1990 Educational Facilities Task Force Final Report (FDOE 1990) requested that pertinent research be undertaken with the intent of answering the following questions:

1. Where are relocatable classrooms being used?
2. How often are these portable classrooms relocated and why?
3. How long do relocatable classrooms remain in use?
4. How do they compare to the longevity and use of permanent space?
5. How are the "core" spaces of a school affected by the use of relocatable classrooms?
6. During severe weather situations such as tornadoes, hurricanes, hail, and heavy rain fall, what is the type and severity of damage that occurs to relocatable classrooms as compared to permanent construction?
7. Are current fire and life safety codes relating to the construction and set up of relocatable classrooms sufficient to protect the occupants and surrounding permanent buildings?
8. Can the requirement for relocatable classrooms be met using other means not presently in use by the districts?
9. Is there a measure of how relocatable classrooms affect the learning of students?

10. What is the cost of maintaining relocatable classrooms?
11. What are the costs of relocating these portable classrooms?
12. What additional costs are included in the initial construction of a relocatable classroom to make it moveable?
13. What would be the cost effectiveness of requiring all new relocatable classrooms being constructed utilizing fire resistant materials?
14. What is the cost of relocatable classrooms as compared to permanent construction?
15. What is the cost per usable year when compared to permanent construction?
16. Taking into consideration their life expectancy, required maintenance, and cost to relocate, are portable classrooms a good investment?

With these specific background questions, the purposes of this study can be seen to be the determination of whether the use of relocatables in the state is indeed a cost efficient and educationally effective means of handling on-going short-fall capacity in permanent facilities or is instead a short-sighted response that may ultimately place undue pressure on taxpayers and the integrity of Florida's school system.

In order to answer these research questions, the following areas of study for relocatables were established: the quality of the physical classroom environment and its impacts on teachers and students equally, construction methodology, economics, current uses and impacts on existing facilities, and safety .

The financial study addressed and compared the short-term and long-term financial issues related to the use of both permanent and relocatable classrooms. Analyses was

provided for a host of comparisons under differing scenarios and assumptions concerning relevant factors associated with available project options.

The physical classroom environment was addressed through a review of literature, teacher evaluations and site visits.

Current uses of relocatables in the state were investigated through information gathered from questionnaires sent to superintendents and facility planners.

Other aspects of the research were gained from industry input and contractors' review of construction documents. Not analyzed as part of this study is parent and student reactions to the classroom environment and tests scores comparing student achievement in permanent vs. relocatable structures.

We now have relocatable classrooms in every school district in Florida. There are over 16,000 thousand units and hundreds more being produced at the time of writing. Over 480 million dollars have been spent on relocatables in this decade. More than 380,000 students and 15,000 teachers (assuming 25 students and 1 teacher per relocatable used for classroom space) spend in excess of 1,080 (180 days x six hours a day) hours a year in these facilities. What effects do these facilities have on our children's learning capacities and well-being? What are the economic impacts? What is the feasibility of continuing the policy of supplying classroom space with relocatable units? The following study was designed to answer these vital questions.

CHAPTER 2

Literature Review

The focus of this review was on existing data and literature dealing with the portable/relocatable classroom and topics related to the physical classroom environment. The review begins with an examination of evidence of the relocatables current use. Thereafter, the review will be organized topically covering literature that corresponds to issues originating from the research questions submitted by the Department of Education. Those topics include: factors that necessitate the use of short-term accommodation; advantages and disadvantages of using relocatables; the physical classroom as a safe, efficient and effective learning environment. The review ends with an overview of the studies on relocatables (the conclusions of these studies are listed in the previous topical sections) and a summary of recommendations found in the literature.

The Use of Relocatables

What is a relocatable? Various documents try to define this movable building type. In the EFL study (1964) over 20 descriptive names were listed. The report goes on to describe four categories which these relocatable structures fall into: portable, mobile, divisible, and demountable.

The *portable* is defined as a structure which is moved whole from one site to the other.

The *mobile* generally relates to a classroom facility designed along the structural patterns of a mobile home, which has a high degree of mobility and a long, narrow shape with widths from 10-14 feet.

Divisables are units that are planned to fit together or come apart as large building components. This type of system incorporates the concept of modularity including as part of this larger component, windows, doors, walls, flooring and utilities, all assembled together for ease of shipping.

The *demountable* facility is defined as a building which has building components such as wall modules that can be disassembled and moved to a new site. This type is the most costly to relocate and takes the greatest amount of time to move. Another definition for this building type from Roy Van Doorn (1991), president of the modular Building Institute, is "school structures utilizing modular construction methods that can be transported over public roads. They are designed to be constructed for efficient secondary relocations without the removal of either the floor, roof, or other significant structural modifications. These structures are frequently called portables, and generally are under 2,000 square feet."

The use of relocatables is widespread throughout the United States. Haviland's poll (1972) found that over half the state institutions indicated some dependance on such facilities. In 1991 California was using 48,000 relocatables: 43,000 for classroom space, with approximately 1.2 million students (27 percent of the total public school enrollment) housed in these portables (Smith, 1992). In Texas, 20 percent of classroom space is comprised of portable buildings, totaling 15.3 million square feet. (Texas Education Agency, 1992). Conclusions drawn from questionnaires to facility planners and Department of Education statistics as a part of this study found that Florida has over 16,000 relocatables.

Factors that Necessitate the Use of Short-Term Accommodation

Over 4 million children were born in 1990, the largest yearly total since 1964. If you add to that number the number of children of immigrants currently arriving you have a growth spike in the mid-1990's for many school districts (Van Doorn, 1992). In California it is estimated that enrollment "in kindergarten through grade twelve will increase approximately 35 percent, from 4.5 million in 1988 to 6.1 million in 1998. To put 6.1 million into perspective, it is equal to the total population of the states of Idaho, Montana, and Wyoming combined...To create school facilities for this growth in enrollment would mean building eleven new classrooms every day, 365 days a year for the nest ten years" (Auditor General's Office, 1991). Total Estimated cost of construction by the year 2000 is 25.3 billion dollars (Smith, 1992). In Texas the population is growing at the rate of 50,000 students per year. The estimated cost to construct facilities to respond to this student growth is $300 million annually. There is also a need for 2.5 million additional square feet of space to relieve overcrowded classrooms (Texas Education Agency, 1992). Florida is also experiencing explosive growth in its school enrollments, with average annual increases as high as 4.2 percent (Florida Department of Education, 1993).

These increases in student populations create management and planning challenges for the school districts. One of the difficulties of planning for these increases is predicting space requirements. Even with sophisticated population analysis, districts can experience unpredictable population changes. If situations where enrollments are higher than anticipated occur, and existing facilities are not adequate to absorb the numbers, short-term accommodation will be required. Some of the circumstances which might require short-term housing for students include when populations shift within a district from one area to another due to changes in land use. One cause of such shifts

is new suburban residential developments or redevelopments close to the city's core. There may also be a land use change that is nonresidential, such as an office building or government facility that causes a population to migrate. Another land use change which may require short-term school accommodation occurs when populations move around due to seasonal or outside factors such as agriculture, tourism, or military employment. Growth spurts can also occur within a district, moving through an area and placing more strain on existing facilities and staff (Metropolitan Toronto School Board, 1970).

Another factor which can create a need for short-term accommodation is when there is a shortage of capital or long-term funds. Districts where growth requires great amounts of capital to finance needed facilities may not have the funds available. Rather than re-design projects to reduce cost, short-term accommodation may be employed using operating budgets (i.e., not capital budgets) until these temporarily deferred projects can be funded (Metropolitan Toronto School Board, 1970), (Van Doorn, 1991).

A third factor creating a need for short-term accommodation is the situation that occurs with the building of new facilities and the upgrading of existing facilities. While new facilities are being constructed the housing needs already exists. Construction may not be completed until the middle of a school year, or may even be delayed due to construction problems. To house the students of this new school a make-shift school consisting of relocatables can be located within an existing facility. Also, when existing facilities need to be upgraded to meet required educational facility standards, students need to be housed. They can be accommodated in relocatables (Metropolitan Toronto School Board, 1970), (Van Doorn, 1991).

A fourth factor that short-term accommodation can provide is the housing for new programs. The introduction of new programs imposed either from Federal, State or local

governments into a school district can give rise to immediate housing needs. Some districts may want to initiate their own experimental programs while construction of additional space would be premature. These program innovations can be studied to confirm this need prior to a commitment to constructing a permanent facility. In addition, that study can also provide design information for use when planning the future facility (Metropolitan Toronto School Board, 1970), (Van Doorn, 1991).

The study also found that using short-term accommodation as a supplement to permanent structures effects considerable economies.

The Toronto study goes on to explain three principles of building growth. The first is expanding buildings in economical units. Building small additions has a higher cost per square foot because the wall to floor ratios are higher; indirect expenses and site work have some fixed costs whether a small unit is constructed or a larger one; project administration costs for construction are also indivisible for both small and larger projects (i.e., cost for professional fees, for site inspections are not any lower for a smaller addition over a larger addition). Districts can avoid the higher cost per square foot for small additions by using temporary housing until enrollment is established to warrant building larger units which can be built at lower per square foot cost.

The second principle established by the Toronto Study is building for predictable needs. If a district can more accurately predict the future demand for space and build only the space it needs and in the right location, it will obtain economies in the utilization of capital funds and minimize risk. By using temporary housing during this period of student growth the district can provide a place for the additional enrollment until it is possible to more accurately predict the future demand for space.

The third principle is building for rapid utilization. By building space that will be utilized soon after it is erected the district can reduce its annual capital budget. Space built for anticipated growth and under utilized in a new facility is uneconomical. Using short-term accommodation during growth and building permanent facilities for rapid utilization can realize savings (Metropolitan Toronto School Board, 1970).

What choices do school districts have when responding to facility planning challenges? They can institute format changes such as year-round education, re-allocation of pupils to other schools, double sessions, changing grade-facility configurations, and adjusting school boundaries. They can decide to overcrowd existing classrooms. They could also re-utilize or increase the space in their existing facilities through additions, renovation and remodeling. Permanent structures such as commercial facilities, community buildings, i.e., libraries, gymnasiums, and churches, can be used through leasing arrangements. Finally, relocatable facilities can be used in conjunction with existing facilities (Bass, 1973; Haviland, 1972; Heyl, 1974; Metropolitan Toronto School Board, 1970; Van Doorn, 1991, 1992).

The Advantages of Using Relocatables for Short-Term Accommodation

Of the choices listed above the relocatable structure offers the best potential for "flexibility and educational suitability" (Metropolitan Toronto School Board, 1970). Roy Van Doorn sums it up by asking "why do districts use relocatables? In a word: flexibility." (12/1991) From Haviland's analysis of schools throughout the country most respondents listed "new temporary buildings" as the choice for their temporary space needs over remodeling existing facilities, leasing space in the community or using rent-free facilities throughout the community (1972). In California's Auditor Generals report (1991) it was

also concluded that the "portable [refers here to a type of relocatable] classrooms are a practical alternative to permanent structures because of their versatility." According to the Toronto study advantages to the use of relocatables are that they satisfy many of the short-term accommodation functions including: crisis space requirements due to enrollment spurts, shortage of capital funds, delays in completion of construction of new facilities, planning and programming flexibility, and growth economies. They are also cheaper than leasing space in other non-school buildings and busing. "Finally, and the most important is the fact that the accommodation given to pupils in relocatable structures can be essentially equivalent to that offered in conventional facilities. These pupils can remain in their own community at the school they normally attend neither losing access to its ancillary facilities, nor suffering breaks in program continuity. At the same time, they can be allocated the same amount of space (and teachers) as is provided in the permanent school" (Metropolitan Toronto School Board, 1970, p. 49).

The Toronto study goes on to enumerate the advantages of the portable relocatable facility: 1) they can be moved quickly from school to school, 2) costs for moving is lower than other relocatables types such as divisibles and demountables, 3) they can be moved one-classroom unit at a time (allowing for incremental expansion), and 4) their initial square foot costs are lower, which can be useful in financial emergencies. Other characteristics of the relocatable that give them advantage over other types of structures is the physical separation from each other and the existing school. This separation offers many teachers a greater degree of privacy and independence, i.e., it allows them to make noise if they need to without the fear of disturbing others, and also fosters a strong classroom group identity, not unlike those established in traditional one room school houses. A survey from the Toronto study revealed that there was "no

evidence that portables have been grossly inadequate as educational facilities" (Metropolitan Toronto School Board, 1970). Finally, many times the relocatables are located on the school grounds and open directly to the outdoors. This allows for the incorporation of programs that use the outdoors and gives the students the capability of coming and going informally (Metropolitan Toronto School Board, 1970).

In Haviland's survey (1972) he also discovered that colleges are looking for small increments of space that had the qualities of permanent construction for temporary uses, and they want it fast. In the California report by the Auditor General (1991) it is noted that "the size and cost of portable classrooms allow school districts to build, replace, or refurbish school facilities incrementally, by adding only as much space as needed....The ease of purchasing or leasing portable classrooms, the number and variety of options available, and the speed with which manufacturers can build the modules suggest that using portable classrooms is a practical alternative to using permanent structures."

The Disadvantages Associated With the Use of Relocatables.

In a review of the 1964 report by the Educational Facilities Laboratories Alan Bass writes, "as of 1964, the consensus of school districts was that such units did not yet meet minimum functional, cost, and aesthetic requirements. Appearances and space were to often sacrificed to meet low-cost budget targets" (1973). The California report of 1968 says that the portables' "origins can be traced back to economic misjudgments, poor planning, and ignorance of the importance of school facilities to the success of educational programs." It goes on to say, "Portable classrooms became an over-the-counter commodity in a highly competitive and lush market...Competition based on price alone tended to hold down the quality level of portable classroom designs...A few designs, most

of them similar in basic concept, became the 'stock plans' of the portable classroom industry. Continued fierce competition has tended to prevent major design changes or improvement in these facilities" (Gibson, Eatough 1968). In the following year the California State Department of Education, Bureau of School Planning summarized their concerns in the booklet titled Portable School Buildings (1969): "The development of the portable classroom has been disappointing when measured by any yardstick of design standards. Most districts candidly admit that their portable buildings do not approach the quality or functional level one might reasonably expect from today's technology, nor do they possess the aesthetic qualities anticipated. Costs are generally higher than the district can justify when it is apparent that this same money can purchase a custom-designed school with similar pace, furnishings, and equipment. Obviously, the best design skills and know-how of architects, engineers, and fabricators have not been focused on the portable classroom" (p.3).

Though the Toronto study (1970) revealed that the relocatable classroom is successful as a solution to short-term accommodation it also pointed out the disadvantages associated with this building type. The study revealed that the majority of existing relocatables are of inferior quality and are ill suited to meet modern educational needs (Bass, 1972). Teachers' recommendations for the improvement of these facilities included: facilities for water and lavoratories, the need for additional storage and insulation from outside noise. Problems associated with the location of the facility on the site consisted of time lost in traveling, weather conditions and transportation of audio-visual equipment. The report goes on to say, "the special advantages offered by the portable should be re-examined in the context of this trend towards greater integration within the school [at the time of this report a trend was emerging that integrated the classroom with

the core facilities similar to the open-classroom concept found in the United States]. Most of the benefits suggested by teachers and principals involved such concepts as privacy, independence, personal territory, and strong group identity. However, the physical isolation inherent in the portable may not be the best way of achieving these social qualities; it also hinders the intensive interaction among teachers and among pupils that will be an important part of new school programs." Other problems relating to site location found in this study included supervising pupils and maintaining discipline (Metropolitan Toronto School Board, 1970). Another negative issue is the large amount of space required for siting, which results in diminished play areas (or parking spaces) (Ontario Department of Education, 1970), (Heyl, 1974).

Harry Heyl, in his newsletter from the Educational Facilities Laboratories gives another disadvantage for the use of relocatables not already mentioned: "portables tend to become permanent" (1974).

Another disadvantage is being able to monitor the safety requirements of the relocatable once it has been relocated to other school sites. In the report from California's Auditor General (1991) it was determined that a substantial number of portable classrooms may not meet state safety requirements. "According to the OSA [Office of the State Architect], state engineers inspected 153 portable buildings at 20 school sites. Only 40 (26 percent) of the 153 portable classrooms that we reviewed and the OSA inspected met state safety requirements. In addition, according to the OSA, school districts were using an additional 35 (23 percent) of the portable classrooms without having received a final inspection and approval from OSA inspectors....As a result, school districts are using classrooms that might be unsafe" (p.13).

The single most prevalent disadvantage of relocatables surfacing in much of the literature is their appearance and effects on a community. "Most relocatable structures currently in use have been stripped of amenities, ostensibly for the sake of economy. In many communities bad taste or no taste at all has been actively chosen over good taste in the belief that 'the public won't stand for our putting a lot of money into fancy frills.' It is understandable, then that community reaction to the first appearance of those gray sheds sitting out in the school yard is usually negative. The inspirational effect on the student entering the unit day after day, or year after year, can hardly be much different" (EFL, 1964). Haviland says that "the visual and environmental character of many temporary facilities, even when not reinforced by poor siting, is often below standards for more permanent quality structures" (2/1972). According to the California report (1968) the public has not accepted the portable because it is recognized as "sterile, monotonous, and unattractive." It goes on to say that the "materials used are generally industrial materials and the result is often inappropriate to the climate, the region, the community, or the other buildings on the site." The Ontario study faults the school boards for the unsightly buildings and for not having design standards set by qualified professional designers (Ontario Department of Education, 1970). In a recent Tampa newspaper article the neighbors of a historic high school object to the school district's plans to locate portables at the back of the school which happens to be right in front of their homes. "We live behind the school and we have a problem with them putting portables in our front yard...the portables are eyesores and the district should create some buffer to soften the impact." (The Tampa Tribune, 1993).

People's perceptions of relocatables have something to do with what they represent. Some view the use of relocatables as a result of poor planning, rather than as

serving the legitimate function of short-term accommodation. Others believe the relocatable provides a significantly inferior environment. Some people associate the relocatable with mobile homes. Others believe a school should present an image of permanence and stability (Metropolitan Toronto School Board, 1970).

The Physical Classroom as a Safe, Efficient and Effective Learning Environment

To answer the questions posed by the Department of Education concerning how relocatable classrooms affect the learning of students, as well as the questions concerning life safety, an extensive review of literature was conducted dealing with the physical classroom environment.

What helps create an ideal setting for learning? What are the ingredients that make for an effective classroom environment? Does the relocatable classroom provide an inferior environment to the permanent classroom? Only one study actually sought the opinions of teachers regarding the effects of relocatables classrooms on their teaching. In the Toronto study the conclusions drawn from a survey of teachers and principals indicated there was no evidence that portables are grossly inadequate as educational facilities. "Most teachers and principals agree that pupils in these facilities do not receive a significantly inferior education" (Metropolitan Toronto School Board, 1970).

Though there has been little research specifically on the learning environment provided by relocatables, a growing body of research exists concerning the physical classroom environment and its relationship to learning and children's behavior. A review of this literature was conducted to evaluate whether or not the relocatable classroom is in fact a suitable setting for educational purposes.

Banning (1992) states that "learning environments are those environments that contribute to the acquisition and maintenance of new patterns of thinking, feeling, and acting that are qualitatively different from preceding patterns." He goes on to give the conditions that are needed to produce the qualitative or structural changes that define learning. Those conditions are:

1) the environment must challenge; 2) the environment must involve; 3) the environment must support; 4) the environment must structure; 5) the environment must provide feedback; 6) the environment must provide for application; and 7) the environment must provide integration. How do the elements of the physical environment support these conditions? The specific environmental variables reviewed by us to address this question are: physical space, light, acoustical environment, thermal environment, air quality, and aesthetics.

Physical Space

"The motivation to interact with the environment exists in all children as an intrinsic property of life, but the quality of the interactions is dependent upon the possibilities of engagement that the environment provides. Hence, in all its manifestations, the environment is the curriculum and the physical parameters of classrooms, as much as books, toys, and work sheets, must be manipulated by teachers as essential aspects of the educational process" (Olds, 1979) A review of literature of the physical space of the classroom focused on the aspects of physical enclosure, spatial definition and arrangement, and density and class size.

There are two classroom spatial archetypes which deal with the degree of physical enclosure. One is the open-space/school where there is a low degree of enclosure with

few hard boundaries. The other is the traditional single self-contained classroom. Problems associated with the open school environment were distraction and intrusion. In Gump's review (1987) of studies on this type of school environment he reported that negative achievement was associated with the open school environment and that conventional school students were superior to the open school students in reading, vocabulary, and mathematics.

The aspect of internal spatial arrangement was reviewed. Classrooms are socio-physical environments where the nature of the physical setting is mediated by the activities that take place (Wachs, 1987). Weinstein (1981) states four basic premises: 1) physical setting of the classroom as an integral element of the learning environment, 2) studies of the classroom environment must take into account the social and instructional context, 3) there is no ideal physical setting that will satisfy all learning situations, 4) the physical setting of a classroom constitutes an external condition that must be arranged as systematically as the other elements of the stimulus situation. Spaces can be organized in terms of personal territories (student "owns" a desk) or functions (interest areas or work centers).

The different types of territorial arrangements for seating include rows or small groups. In a study by Wheldall & Lam (1987) involving 12 - 14 year old students they found that: 1) seating arrangements have significant effects on children's behavior and on the behavior of their teachers; 2) proximity and face-to-face relationship of pupils in the tables' arrangement facilitates disruptive and off-task behaviors; and 3) rows formation is superior to tables' arrangements for individual academic work - student conduct improved, accompanied by on-task behavior. 4) rows' arrangement is inferior for topic work and group discussions. From research on spaces organized around functions Weinstein

(8/1981) gives the following design principles: 1) interest areas should be clearly delineated or bounded; 2) areas should be located according to the requirements of their respective activities for quiet, protection, and special resources (water, electricity and light); 3) incompatible activities, such as block play and reading, should be well-separated; 4) all areas should be visually accessible to students; 5) pathways should be clear and should not go through work areas; 6) large spaces that encourage rough-and-tumble play should be avoided; 7) the teacher's desk should be placed in a corner to encourage his or her movement around the room; 8) materials must be easily accessible and should be close to work surfaces; and 9) classrooms should contain spatial options - places to be alone, to work in small groups, to be in large groups (p.16). Hathaway (1988) comments on the importance of both public and private spaces in the classroom. "Children may need access to private space...to explore their capabilities and to take some risks without observation or fear of ridicule for failure...(they) also need spaces which they can withdraw. To be under constant observation may be counterproductive and it may also have stressful effects" (p.9).

How many children should be assembled in a classroom? Hundreds of studies have focused on this question. Usually we determine the square footage of space to determine size of a group. Another set of dimensions refers to "resources, to behavioral supports and opportunities" (Gump, 1987). For example, a larger pace is one with more behavioral settings for activity. Many times we say that a class size is 30 or 25 pupils. To better understand the classroom size the relationship of spatial area to the number of pupils must be determined - referred to as density. Issues of density of different levels from pre-school to high school and college were reviewed. In highlighting preschool size/density research Gump reported that 1) 25 sq. ft. per child did not create negative

behavior if there were adequate play resources. Negative effects were demonstrated at 15 sq. ft. per child. 2) Increased density though creating changes in behavior is not always negative. 3) Group sizes over 15 children are associated with negative effects on teacher interaction with children, on social and participatory behaviors of children, and on cognitive development. Not only is understanding of the density ratios important but also the activities that occur in the space. For example, in one study cited by Gump it was found that increased densities in group discussion activities reduce achievement. From another review of the literature on class size Stockard and Mayberry (1992) reported that increases in achievement are noticeable only when classrooms are smaller than about 15 students. When medium and large classes were compared few differences were noticed. Smaller classes had 1) friendlier environments; 2) climates that were more conducive to learning; 3)individualized instruction; 4) more interested students; and 5) less apathy, friction and frustration. Teacher morale was also higher, with greater satisfaction with their students and with their own performance. (p.43)

Light

Most environmental designers recognize the importance of adequate light levels for reading tasks and other activities in the classroom. This visual efficiency has a marked effect on many academic outcomes (Dunn, Krimsky, 1983; National Society for the Prevention of Blindness, 1963). However, consideration must be given to broader aspects of light (radiant energy) which includes all bands of electromagnetic energy, light energy (ultraviolet, visible, and infrared) and short wave radiations such as X-rays (Hathaway, 1988). Research conducted in this area has revealed that the quality of the lighting environment can have subtle but powerful influences on how we work, feel, and function

(Lighting, 1986; Belcher & Kluczny, 1987). Some of the biological effects of light include the common examples of sunburn and tanning the skin. In addition, light levels have an effect upon subjects metabolic rates, the speed of circulation of their blood, and their body temperatures. Light therapy is used to treats tens of thousands of infants with jaundice every year. Ultraviolet light promotes synthesis of vitamin D in the skin and helps us avoid rickets and dental caries. Light therapy has been demonstrated to prevent or cure softening and brittleness of bones in the elderly (Wurtman, 1975; Belcher & Kluczny, 1987). Light influences biological rhythms such as sleeping, wakefulness, feeding, and body temperature. The pineal gland, located in the brain, secretes melatonin, a hormone, during periods of darkness. This hormone affects sleep, ovulation, and the secretion of other hormones. In addition, illumination levels influence the production of cortisol, the "stress" hormone (Lighting, 1986; Belcher & Kluczny, 1987; Hathaway, 1988). "If typical indoor lighting levels are too dim to trigger the hormonal changes that synchronize our internal clocks, what are the implications for people who spend most of their time indoors? And if light is a key ingredient in synchronizing our body rhythms, what other as yet poorly understood effects might it have on our health, productivity, moods, and energy levels?" (Lighting, 1986). Evidence reveals that light can affect mood, productivity, risk taking, aggression and noisiness, as well as subjective judgement. Most important, in a report by Belcher & Kluczny (1988), findings showed that lighting affected the decision making process and that mood and arousal potential need to be considered for good lighting design. In addition, they concluded that the decision task, not just the visual task, must be considered. For example, "In an office some decision tasks may actually be enhanced by reducing visibility since the model predicts that this will encourage the use of simple, cognitively efficient, decision strategies" (p.54).

Dunn & Krimsky (1983) maintain that results from generalized group reaction to lighting conditions do not adequately reveal the distinctions of individual student learning style preferences. They found that "scores on both reading speed and accuracy were consistently significantly higher when the illuminated instructional environment matched the student's diagnosed learning style preference for light. Thus, those students who preferred 'bright light' performed significantly better when tested in the brightly illuminated environment and those who had indicated that they preferred concentrating in 'dim light' did equally well when tested in the low light setting. Both groups performed less well when tested in mismatched situations." A report by Cohen and Trostle (1990) examines the environmental preferences of children. They found that younger and older children, and boys and girls respond differently to light, with older children and girls showing a significantly stronger preference for brightly lit objects.

The findings of a study titled, "A Study Into the Effects of Light on Children of Elementary School Age - A Case of Daylight Robbery" (Hathaway, Hargreaves, Thompson, Novitsky, 1992) support the conclusion that "lighting systems are not neutral - they have non-visual effects on people who are exposed to them over long periods of time." They found that those that had ultraviolet supplements (these supplements were from full spectrum fluorescent lights) had fewer dental caries; demonstrated the best attendance; the greatest gains in height and weight; and the best academic achievements than did those who did not receive supplements. Questions remain as to where the boundary lies between the risks and the benefits of ultraviolet light. The study was conducted in Alberta Canada, i.e., in a region between 49 degrees and 54 degrees north latitude, a region noted for its short periods of daylight.

The use of new technologies such as computers and televisions in the classroom not only complicates lighting system design with concerns of glare and the surface characteristics of the glass screen but raise issues of electromagnetic radiation outside the visible light range, the effects of which are essentially unknown (Hathaway, 1988).

Available research on the effects of windowless classrooms is sketchy. A study by Larson (1965) "The Effects of Windowless Classrooms on Elementary School Children" found that "no pattern of class behavior indicated that a view of the outdoors was essential to the learning process. Also, no consistent pattern of pupil performance was detected that could be attributed to the absence of an outside view. Classroom windows were found to have little, if any, effect on a child's ability to learn" (McGuffey, 1982). A study by Romney (1975) "The Effects of Windowless Classrooms on the Cognitive and Affective Behavior of Elementary School Students" found that "no consistent trend emerges to allow one to pass definitive judgement that windowless classrooms are detrimental to student cognition and learning....The only definitive trend is in the realm of affective behavior, indicating that student aggression increases in windowless environments. Also...teacher frustration increases" (p.47).

Acoustical Environment

Most studies left little doubt that noise can create sufficient interference with verbal instruction to hinder learning. Background noise can mask background sounds and interfere with aural perception just as reflections and reverberations of sound can inhibit normal hearing. (Hathaway, 1988) This becomes an important factor when designing instructional environments for the hearing impaired. Moreover, unwanted noise and vibrations from outside sources serve to elevate anxiety levels. (p.10) An advisory group

for the University of California, Davis distributed a survey to their faculty and students (Babey, 1991) to determine classroom quality. One of the problems identified was noise caused by the air conditioning system. Those faculty using hearing-aids had problems because the hearing-aids amplified the mechanical sounds, making hearing of desired sounds difficult. Foreign language faculty also complained because noise from the mechanical systems prevents students from hearing fine sound differences in other languages. Conners (1981) in a review of Weinstein's (1979) research on sound reported that studies of short-term exposure to moderate noise originating within the school do not correlate significantly with differences in student performance.

Though some of the findings on background noise affecting student performance is mixed, evidence from studies undertaken in classroom environments where there is chronic exposure to noise, i.e., those near airports, train tracks and highways, reveals adverse effects on students and teachers (Wohlwill & Heft, 1989) Some of these effects include higher systolic and diastolic blood pressure; a greater failure rate on puzzle-solving tasks with a longer length of time to complete the puzzle; and lower math achievement and reading performance. Teacher behavior is also affected by these high noise levels which may adversely influence educational activities.

Dunn, Pizzo, and Hanna (1983) found that there were problems with research that was conducted comparing large group reactions to a given variable. They provide a better model by an examination of how each individual "achieves better, more easily, and/or retains longer when selected strategies or resources that complement a specific trait are provided. (p. 18) They conclude that learning style is biological and has its basis in the structure of the individual's neural organization and personality (National Task Force, 1983). Therefore, aspects of gender and age must be examined. They cite research

(Pizzo, 1981) that revealed 1) "students with a preference for quiet performed best in a quiet acoustic environment, and 2) students with a preference for sound performed best in a noisy acoustic environment, 3) students in an environment that complemented their learning style preference also evidenced statistically higher attitudinal scores than their mismatched peers, 4) a mismatched environment not only impaired the quality of student reading achievement, but also detrimentally affected students' attitudes toward their own intellectual ability, physical and emotional strength and emotional stability" (p.19).

Thermal Environment and Air Quality

McGuffey (1982) reviewed nine studies on the thermal environment of the classroom and found (even though some studies had sampling limitations, and generalizations) that eight of the nine studies concluded that thermal factors have a significant impact on school achievement and performance. Factors fundamental to achieving thermal comfort are: radiant temperature, air temperature, air movement, and humidity. In a review of research on optimum temperature levels Hamer (1974) reported that temperatures above 74'F adversely affected reading and mathematical skills. In another study (Murrain, 1983; Dunn & Dunn, 1984) temperature preferences were found to vary between the sexes and among age groups. People exhibit drastically different reactions to heat and cold.

Natural ventilation and air quality are becoming more important as we realize the savings gained by naturally cooling our facilities and the risks associated with indoor air pollution. Florida has the advantage of having many days where natural ventilation could be used in lieu of air-conditioning. From the survey of faculty and students at the University of California, Davis, cited previously, temperature and ventilation was one of the

major problems listed with their school environment. Faculty were particularly critical of poor ventilation and the inability to open windows. A quote from Halstead's (1974) book on state planning cited in that report says: "It is generally recognized that high temperature and humidity produce physiological stress that accelerate fatigue, cause people to work more slowly, exert greater effort, and make more mistakes. The classroom climate in particular should be carefully controlled not only to provide physical comfort but also to serve as a positive factor in the learning process by engendering alertness and attention. To maintain such a climate, the air must be treated to simultaneously control temperature, humidity, cleanliness and circulation" (p. 503). The fourth largest environmental risk to public health according to the U.S. Environmental Protection Agency (EPA) is indoor air pollution. Though the effects of thousands of individual low-level pollutants and their interaction with one another have not been verified, there are many cases of illnesses such as headaches, eye, nose, and throat irritation, dizziness, nausea, and fatigue which disappear outside the workplace. These are frequently categorized as "sick-building syndrome" (Harriman, 1993). The hazards of radon and asbestos have been quantified and measures are underway in many schools to remedy the problems. The causes of sick-building syndrome are more difficult to uncover, making it difficult for design professionals to address. Inadequate ventilation can be addressed by boosting outside (make-up) air supplies. However, this lowers the energy efficiency of buildings. Opening windows can help, but unfiltered outside air may be equally contaminated. According to Harriman increasing ventilation is not the only solution to improve air quality. Pollutants must be prevented. The following is a list of indoor air pollutants: volatile organic compounds - VOCs (paints, adhesives, building materials), environmental tobacco smoke, formaldehyde (particle board, plywood, furnishings and upholstery), pesticides, asbestos

(building materials), biological contaminants (bacteria, viruses, fungi, mold, spores, pollen which can come from animals, humans, poorly maintained HVAC systems), polycyclic aromatic hydrocarbons - PAHs (tobacco smoke, kerosene heaters), and, combustion gases (carbon monoxide, nitrogen dioxide, sulfur dioxide). Temperature and humidity also affect these pollutant levels. It is important not to occupy a facility until the off-gassing of toxins from building materials decreases (p.122).

Aesthetic and Symbolic Aspects

There is little research addressing the effects of classroom visual appearance on student behavior and achievement (Wohlwill & Heft, 1987). In two studies reviewed by Weinstein (1981) the effects of a more visually pleasing and comfortable environment increased the level of student participation.

In a survey of faculty and students on the quality of the classroom environment at the University of California, Davis (Babey, 1991) it was found that the aesthetic quality of the classrooms was identified as the number one problem area. Halstead (1974) in his book on state planning in higher education says, "to a greater extent than perhaps any other type of institution, colleges and universities need to create environments suitable to living and working. The largely indoor pursuit of teaching and learning requires that the character of instructional space_its shape, climate, lighting, color, acoustics, and seating_be conducive to highest level of communication and mental productivity." (p.501). Addressing the settings for office workers Styne (1990) says, "People are greatly influenced by the visual aspects of their environment....People are able to perform best when they are visually comfortable" (p.78). In another survey that focused on aesthetics of the classroom that developed out of the University of California, Davis study (Calwell

& Hoyt, 1990) it was concluded that "there are two problems with classroom design that influence aesthetic preference and ultimately instructional function. The first problem is that current room design features do not support the experiential needs of the users. Students and faculty desire rooms to be bright, spacious, large, natural, organized, harmonious, comfortable, airy, functional, inviting, happy, interesting and beautiful. Many classrooms do not support these needs. The second quality in current classrooms design that does not support aesthetic appreciation or instructional tasks is the larger problem of crowding....the majority of respondents indicated that the ideal classroom should be 'spacious,' 'large,' 'comfortable,' and 'airy'" (pp. 10-11).

The physical design of the classroom is a source of nonverbal communication. The school, the classroom and its surroundings convey messages to the student, teachers and parents about the importance and priority of education. Hathaway (1988) defines perceptual constraining factors of the physical educational environment as those messages that the buildings give us about themselves, they attest to the fact that buildings are not neutral - "indeed, the building itself is a message" (p.8). He gives the example of the design of a building that disregards energy conservation and ecological considerations. "What messages do our children learn from (these) school buildings when they attend" (p.8). When children with disabilities do not have access to a facility what is the message conveyed to that child? Also, the educational philosophy of the teacher is communicated by the way she or he arranges and decorates the room (Sommer, 1977). Weinstein (6/81) in her article suggests further research in the area of "impression formation". "Do impressions formed as a result of the physical setting (of the classroom) affect subsequent behavior toward the teacher?" (p.395).

Summary on the Physical Classroom Environment - Though there is still question as to impact of the physical environment of the classrooms on achievement the evidence for impacts to behavior seems answerable on the side of empirical evidence (Banning, 1992). According to Weinstein the findings of these studies of the physical environment are important for the following reasons:

1. It is possible that more positive attitudes and behavior may eventually result in improved achievement.

2. The business of schools is not academic performance alone but a place for developing the whole child, instilling enthusiasm for learning, and encouraging positive social relationships.

3. The results of these investigations provide empirical evidence that classroom design can hinder or facilitate the realization of a teacher's instructional goals (p.189).

Safety.

We reviewed articles related to the recent Hurricane in South Florida (Andrew) and its effects to the school facilities. From a report by the Broward County School Board (1992) on the effects to School facilities in Dade County they said: "Portables were destroyed due to failure and/or lack of anchorage. One portable was observed to have lost its stud connection to its floor. Portables were observed to have been shifted on their foundations. Portables were also highly susceptible to the other types of observed damage: roof loss, breaking of glass windows, and impact damage from airborne debris.

As most masonry construction could more easily withstand the storm, the lighter portable construction was heavily damaged and more subject to collateral damage" (p. 4).

According to Van Doorn (Dec.1992) of the 3,500 modular classrooms in use in Dade County Florida, only two were seriously damaged in the hurricane zone.

An advantage of relocatable classrooms is their ability to respond to the recover efforts after a disaster such as the hurricane in south Florida by providing space in a timely manner where there was a loss in functional classrooms.

Studies on Relocatables

In 1964 the Educational Facilities Laboratories (EFL) produced a document summarizing two years of field research on the subject of relocatable school facilities. The document describes the problems of overcrowding, double-sessions, fluctuating enrollments and explains how the relocatable has become a solution to these challenges. The report goes on to review the problems of relocatables historically and then analyzes these units according to cost, transportation and quality. The study involved the cooperation of 40 individual school districts in 18 states. The report concludes by making projections concerning the future use of relocatables. (*The conclusions of this and subsequent studies are addressed in the topical sections preceding this section.*)

A report by California's Bureau of School Planning, California State Department of Education (Gibson & Eatough, 1968) criticizes the use of portable buildings as a solution to California's growing student population and discourages their use. The report continues with a summary of the use of portables in California, gives the reasons districts buy portables, and its reasons for not supporting their use due to the problems they create. The report concludes by recommending further study into the "true and total" cost

of these facilities, recommending that the opinions of educators and facility professionals be sought and evidence be gathered to determine whether or not portable facilities retard educational progress and create fiscal difficulties for districts.

A year after the previous report, the Bureau of School Planning published a booklet entitled "Portable School Buildings." (California, 1969) This document is an extended version of the report listed previously, disseminated with the intent of informing school districts, facility planners and manufacturers of the Bureau's criteria and policies regarding portable classrooms. The first part of the document focuses on the use of portables in California, the reasons districts purchase them, and discusses Bureau policy regarding portables. The second part of the document lists performance specifications. Part three presents an evaluative questionnaire responding to the performance specifications and intended to identify design deficiencies. Part four discusses problems which result from conflict with Title 21 of the California Administrative Code. These conflicts arise out of differences between pre-fabricated construction and permanent (site-built) construction, specifically, how compliance with regulations and inspections are different for the two construction systems. This results in portable units not complying with minimum safety levels and the architect being unable to adequately inspect the construction work prior to field installation. A list of questions relating to relocatable manufacturer's compliance with State codes is answered by the State attorney general. The final part of the document discusses the procedure for acquisition of portable buildings to insure district-wide compliance with the Education Code.

Twenty one years later (1991) California's Office of the Auditor General presented a report concerning the safety, uses, and cost of portable classrooms in California school districts, and the time it takes to acquire them. The scope and methodology of the report

involved a review of laws, regulations and policies governing acquisition and use of portable classrooms, and observation of school sites to determine how they were used and whether they had been inspected. Data was also reviewed concerning the extent of damage caused by earthquakes. A random stratified survey of school districts was conducted to determine the number of portable classrooms and how they were being used. Costs were analyzed as well as methods of funding. Finally, there was a review of the process and estimated time to acquire the portable classroom. (Auditor General 1991)

The Study of Educational Facilities (SEF) initiated by the Metropolitan Toronto School Board (1970) analyzes the problem of short-term accommodation, including an evaluation of the present use of relocatables and alternative ways of meeting short-term needs. The document begins by discussing how temporary space can meet short-term student housing needs. It evaluates the portable classroom as the major form of short-term accommodation. As part of the study user opinion was surveyed. The survey consisted of two questionnaires, one to principals and the other to teachers. The final part of the document focuses on the proposal of a new system of school facilities that combines permanent and relocatable facilities as two different but equal parts of the whole facility. It then describes basic design and performance requirements for relocatable facilities. The study concludes with a plan for implementation of this new system for relocatables.

Another document from Canada prepared by the School Planning Building Research Section in conjunction with the Ontario Department of Education (1970) supplied guidelines for relocatable structures, current use and average cost, and teacher and community reactions. A conclusion from the report states that "we must re-evaluate our standards of quality, function, aesthetics, and life expectancy. It is reasonable to assume

that today we should expect more than the obviously minimal structures we see around us. New materials, improved construction methods, and new fabrication techniques utilized by competent and qualified design professionals make it possible to expect a higher standard of design and performance at little or no increase in cost." The final part of the document included design guidelines and various plan arrangements (Ontario Department of Education, 1970).

An "Analysis of Alternative Uses of Permanent and Relocatable Construction for the School District of Flagler County," Florida (Brown, 1992) was a study to investigate construction techniques employed in building the relocatables and to ascertain information about cost, life expectancy, and quality. Recommendations were given including site and building design considerations.

A survey sponsored by the American Institute of Architects' Committee on Architectural Education, the American Association of Junior Colleges and the Association of University Architects, developed by Robert E. Entzeroth, AIA, was mailed out to junior and senior colleges around the country seeking information about the "nature, uses, costs, construction and planned disposal of 'temporary' facilities" (Haviland, 2/1972). The analysis of 160 responses to the survey questionnaire (50 of which reported no use of temporary facilities) conducted by David Haviland, provides significant information concerning the use of temporary facilities. The life expectancy of a large proportion of the temporary buildings reported on ranged from 10 - 20 years, and many could probably last longer. The level of quality was similar to that of conventional new construction. Cost information on these facilities showed that they were not significantly below comparable permanent facilities and did not reflect inexpensive makeshift spaces. The most common characteristic of temporary facilities was not cost or projected life but use. "It is the

projected use of the facility which is temporary, not necessarily the physical structure itself" (Haviland, 2/1972).

Not a study but an important document that establishes procedures and requirements for relocatable classrooms is the "Handbook for Relocatable Classroom Units" (Alabama State Building Commission, 1978) This document sets minimum standards for school facility safety and utilities for electrical, water, sewer, etc. including construction requirements and procedural requirements for approval of plans, acquisition and final acceptance of completed projects.

American School & University has devoted many articles to modular construction that have been helpful in this study. Roy Van Doorn, President of the Modular Building Institute, has contributed many of those articles and was a very valuable resource for information on modular construction and the role of the relocatable industry.

Not a study but an experiment of a new approach using relocatables from Orange County Public Schools in Orlando, Florida involves the development of a portable classroom which is structurally stronger with a longer "life expectancy" of 40 years plus. The district designed and built the portable. The success of this portable design led to the development of an entire school campus plan using only relocatable units for classrooms with only the core facilities being constructed on-site (Cascaddan, Ewart & Schott, 1987).

Recommendations Concerning the Use of Relocatable Found in the Literature

Planning Recommendations:

1. Districts should make a utilization study. This would include enrollment projections, the number and location of existing relocatables within the district, the number and size of permanent classrooms (seat count), and a prediction of whether increased student loads are likely to be permanent or temporary (American School & University or AS&U, 1972).

2. Sites for relocatables should be decided before they are needed. The best time to decide where relocatables will be placed is when the architect is preparing the plans for a permanent school building. The location should be determined in the campus master plan. Also, site preparation and utility connections can be made during the construction of the permanent facility (AS&U, 1972; McKinley, 1991).

3. A campus plan instead of the straight row plan provide for and opportunity of social interchange and the exchange of ideas and information (Educational Facility Laboratories [EFL], 1964; AS&U, 1972).

4. Determine the best siting location to facilitate the ingress and egress requirements of relocatables and look for sites that would leave the campus with the least amount of site damage after removal (Van Doorn, 12/1991).

5. Place relocatables within a reasonable distance of other school buildings. They should be located where there is natural circulation and access to other school programs, but avoid, if possible, placing where they "stand out like sore thumb" (Heydt, 1989).

6. In the interest of public relations, and your own sanity, avoid placing modulars to close to surrounding neighbors (Heydt, 1989).

7. Place on blacktop area if possible rather than turf. Blacktop often proves more cost effective in light of avoiding maintenance costs resulting from sand, dirt, etc. brought in to buildings from turf areas (Heydt, 1989).

8. Avoid placing modulars over existing gas, water or other service lines that would create a hazard or impede routine or emergency services (Heydt, 1989).

9. Review topographical situations before the units are sited to facilitate the possible handicap ramping or to minimize any step requirements (Van Doorn, 12/1991).

10. Analyze the power, water, or water disposal requirements that this new structure will have on the campus site (Van Doorn, 12/1991).

11. Review the possible foundation systems to facilitate seismic, wind and soil conditions (Van Doorn, 12/1991).

12. Review what architectural enhancements would benefit a variety of sites. Remember, this structure is designed to be relocated to other sites (Van Doorn, 12/1991).

13. Landscaping around even a minimal structure that has been stripped of architectural amenities can cover the visually poor appearance of the facility. And, the landscaping can also be planned to be relocatable (EFL, 1964).

14. Physical fire separation between units and existing facilities is required for structures which have combustible construction. 10-foot minimum separation is given in EFL Study (1964). A thirty foot separation from permanent school buildings and other units when main glass area face each other (Alabama,1978).

Design Recommendations:

1. Have an architect develop the appearance concept that your district feels would enhance existing schools and future school sites (Van Doorn, 5/1992).

2. Instructional space shall have a minimum of 30 sq. ft. of floor area per occupant. Ceilings heights shall be a minimum of 9'8". Beam clearance shall be a minimum of 8'10" (California, 1969).

3. The following dimensions must equal or exceed the minimum shown: 1) Floor to ceiling - 8'-0", 2) Exterior width - 20', 3) Clear instructional area - 640 sq.ft., exclusive of storage, toilets, etc (Alabama State Building Commission, 1978).

4. Ceiling heights are determined by roof slope and over-all heights to meet transportation standards. Flat roofs should be 9 feet. Sloped roofs minimum of 8 feet (ODOE, 1970)

5. Use the engineering, internal design and construction capabilities of the modular industry (Van Doorn, 5/1992).

6. Beware of new codes mandating fire safety, such as flame spread, alarms, number of doors, or proximity to existing structures (Van Doorn, 12/1991).

7. Select materials for the exterior that are the most durable consistent with the economy (Ontario Department of Education - ODOE, 1970).

8. Interior materials should be maintenance-free and mar-proof. Carpeting is recommended. Carpeting colors should not show dirt or soil easily. Light neutral colors should be used on the walls and ceiling. Accent colors should be used sparingly (ODOE, 1970).

9. The windows should start no less than three feet from the interior floor and be of a type that prevents the opening of window into a passage or play area. There should be no windows within six feet of the chalkboard in order to prevent glare and reflections. Blackout facilities should be provided on all windows for the use of audio-visual equipment (ODOE, 1970).

10. Minimum total window area per classroom shall be 120 sq. ft. Sill height shall not exceed 32" on a major wall (California, 1969).

11. Area of one wall shall have a minimum of 16% of that area composed of operative windows. Opposite this wall to be provided with minimum of small ventilator type windows mounted near ceiling (Alabama State Building Commission, 1978).

12. Illumination levels should not be less than 70 foot candles at desk level. Fluorescent lighting fixtures should run perpendicular to the students' work surface. A light fixture should be provided on the outside of each exit. A single row of fluorescent lighting fixtures should be provided over the chalkboard surface (ODOE, 1970).

13. Minimum reflectance values for interior surfaces shall be: 90% ceilings; 70% walls; and 20% chalkboards (California, 1969).

14. The following essentials are required to maintain a comfortable thermal environment in the relocatable: a) individual room control, b) rapid morning warm up, c) good air distribution, d) quick response to thermal changes, e) air filtration, f) quiet operation, g) adequate ventilation for air freshness and odor control, h) up to 100 percent of system's total capacity for ventilation cooling, i) cold window downdraft control, j) flexibility for relocation of building (ODOE, 1970).

15. Exterior walls and roofs shall be designed to provide a minimum of 35 decibel reduction from exterior noise sources within the 50 to 500 cycle range. Exterior walls and roof shall be designed to provide a minimum of 45 decibel reduction in locations of high external noise from aircraft or freeway traffic (use of sound seals and double glazing is recommended in these areas) (California, 1969).

16. Carpet, acoustic ceiling tile and vinyl wall covering add greatly to the control of noise level (ODOE, 1970).

17. Where the use of audio-visual equipment is anticipated, four duplex electrical receptacles are preferred (ODOE, 1970).

18. Plumbing toilet facilitates are required when classroom unit is used by pupils of first four grades and classroom or library unit is used by grades 5 through 12, inclusive, when existing girl/boy facilities are more than 200' from classroom unit (measured as pupil must walk to existing facilities) (Alabama State Building Commission, 1978).

19. Always continue the exterior finish to grade level. Never leave a building looking unfinished. By finishing to grade, you have also eliminated the potential curiosity factor and liability of children (Van Doorn, 12/1991).

20. Using color through contrasts and detailing can change the box-like appearance. The colors should create a balance with the buildings in the community while maintaining a clear crisp presentation. Do not use colors that will fade, deteriorate or require a great deal of maintenance (ODOE, 1970).

21. The following recommendations concerning the aesthetic issues of relocatable design are from John McKinley (1991) an architect practicing in San Diego and San Francisco who specializes in planning and designing educational and instructional facilities: "Effective relocatables will feature design elements that echo those found in the campus' permanent buildings. These include: Colors. Relocatables may be painted or trimmed to match the color of the permanent buildings. Exterior finishes. The use of exterior cement plaster improves both the appearance and the durability of relocatables. Exterior lighting. Decorative lanterns or other fixtures help to give the relocatables a less-institutional feel. Window and door coverings. Awnings or canopies also help create a more comfortable atmosphere. Covered walkways. If covered walkways are used in the permanent portion of the campus, this element can provide a very strong visual, physical and emotional link if it is extended to the relocatables. Solid floors. The bounce of a relocatable's floor underfoot can be a constant reminder to the occupant that he or she is not in a 'real' building. The floor can be reinforced by increasing the number of joists. Relocation of air-conditioning. Side-mounted air-conditioning units can be more than an eyesore, they can be the target of costly vandalism attacks. Units placed on top of the relocatables are not only better sheltered from view and from harm, they circulate air more effectively.

Enhanced lighting. Increasing the amount of lighting or adding a skylight can help brighten the interiors of the relocatables. Landscaping. A few well-placed shrubs and trees can lessen the impression that the relocatables suddenly emerged out of a sea of asphalt or grass and may be gone again tomorrow." (p.58)

Acquisition, and Quality Control

Recommendations:

1. By purchasing pre-planned and pre-built structures from various fabricators and suppliers the district can achieve considerable savings over custom built, one-of-a-kind units. Buyers must be willing to purchase within the limits of the manufacturers specifications, verifying that those specifications meet district and state requirements (EFL, 1964).

2. Wherever possible, place quantity orders for buildings (perhaps in cooperation with a neighboring community) to realize dollar savings and achieve consistent quality control (EFL, 1964).

3. Even though relocatables can be supplied faster than any site-constructed building, be realistic about delivery schedules (Van Doorn, 12/1991).

4. Ask suppliers for ideas and solutions to your problems (Van Doorn, 12/1991.

5. Before you purchase or lease make use of referrals and visit sites where your chosen supplier has provided other relocatable facilities. Review warranty obligations (Van Doorn, 12/1991).

6. Maintenance, as with any quality structure, will both enhance the appearance and extend the useful life span of the structure (Van Doorn, 12/1991).

7. Require that the Office of the State Architect inspect and certify each school building, including portable classrooms, separately instead of as a single project (Auditor General, 1991).

8. Require that the Office of the State Architect's certification of final approval should state the type and location of the structure that has been approved (Auditor General, 1991).

9. Require that school districts maintain and post copies of certifications for each of their facilities at both school sites and district offices (Auditor General, 1991).

Performance Specifications:

1. Develop a performance specification clearly stating the requirements to be met but without describing every nut and bolt so bidders can attain requirements more economically. These performance specs should be written months in advance (AS&U, 1972).

2. Review and stipulate the quality of materials that you expect to have included in the structure. Set the same material standards that you expect from on-site constructed facilities (Van Doorn, 12/1991).

The Toronto Concept. The "basic design concept is a new type of school building in which relocatable and permanent structures are combined as two different but

equal parts of the whole facility. This approach is actually only an incremental change from the existing combination of school buildings and portable classrooms.. What is important in this concept is the elevation of relocatable structures from an incidental and somewhat inferior supplement to the conventional facility pattern, to an integral and equal part of a new facility pattern" (Metropolitan Toronto School Board, 1970, p. 89).

The Orange Florida County Concept. In an effort to meet the needs of student housing equal to fifteen new elementary schools in five years the school district of Orange County developed a new approach (similar in intent to the Toronto concept) to their facility design (Cascaddan, Ewart & Schott, 1987). The following aspects summarize that concept:

1. The design of a more permanent type relocatable using a stronger and more permanent construction system that would give a longer life expectancy of 40 years plus.

2. Use of district personnel to construct and locate facilities.

3. Relocatable units are rectangular, 24 feet wide and 44 feet long. They have a nearly flat roof and stucco-like exterior finish with no projecting utility connections or air-conditioning units.

4. The air-conditioning system utilizes three ventilator type units which are flush with the exterior.

5. The relocatables have improved acoustics, glare free chalkboard locations, cross ventilation, two means of egress, improved task lighting, and self contained toilet facilities in each unit.

6. The core facilities are constructed on-site and designed to be architecturally consistent with the design of the relocatable classrooms.

7. The classrooms are connected to each other and the core by the means of an elevated walkway system. This elevated walkway allows for utilities and a level transition to classroom units. Above the walkways is a covered roofing system which forms a "spine" to connect all segments of the plan and give a sense of architectural unity. Within this covered walkway spine is an above-ground utility chase system that allows the relocatable classroom to "plug" into electrical and communication lines.

8. With this concept the size of the school can vary from eight to 36 classrooms.

9. Cost comparisons between this type of construction and the on-going conventional construction in the school district indicated that at least one third of the cost of a conventional school could be saved with the relocatable concept (pp.90,91).

CHAPTER 3:

Methodology

The following section describes various methods utilized throughout the process of this study. Some of the areas of research covered in detail are: literature search, facility planners' questionnaire, teacher's survey questionnaire, site visits to facilities, meetings with industry representatives, site visit to manufacturing plant, and financial analysis.

Literature Search:

Literature dealing with relocatables and related topics was searched through international, national and state databases, Educational Resources Information Center (ERIC), Avery Architectural Index, DIALOG (Commercial Resources/Information Database), the Library User Information Service (LUIS), the card catalog and readers guide database of the State University System of Florida; letters sent to all of the State Departments of Education; the Federal Department of Education, Washington D.C.; the American Institute of Architects, Washington, D.C. and the Modular Building Institute, Charlottesville, VA; Ontario Department of Education, Department of School Business and Architectural Services, Ontario, Canada.

Materials collected from these sources and searches were reviewed for their relevancy and then collated into the following categories: physical classroom environment, construction methodology, economics, history, facility planning, and general topics concerning relocatables. Documents collected from the different State Departments of Education were included within a separate file with documents received from the Florida

Department of Education in its own file. Another file was created for construction documents and specifications. A bibliography of over 207 listings was developed from this search.

Facility Planner Questionnaire:

A 58 question questionnaire was developed for superintendents and facility planners to elicit information on the current use of relocatables in their districts and comparisons with traditional facility construction. Other areas covered in the questionnaire included: district policies, safety concerns, planning impacts on existing facilities, life expectancy, maintenance, cost and finance issues. [See Appendix A for a sample of this questionnaire.] The questionnaire was distributed to all 67 school districts. The responses tabulated, analyzed, transformed into graphic forms, or compiled, extracting main concerns from each narrative answer. Patterns were deduced and general trends established. Fifty-seven of the 67 school districts responded to the questionnaire. [See Figures 1, 2A, 2B, and 2C]

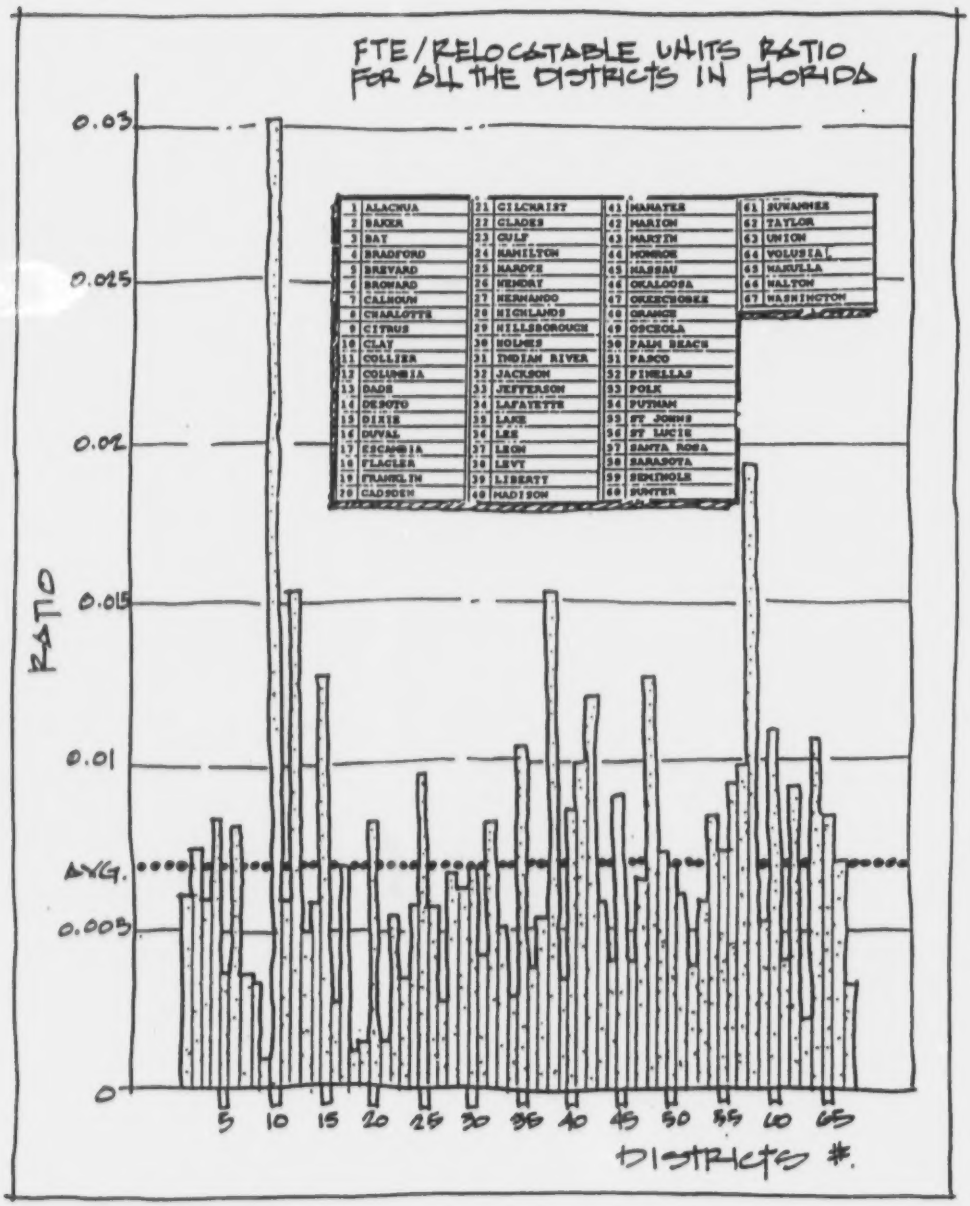
Teacher's Questionnaire:

A 40 question questionnaire was developed for teachers using relocatables to elicit information about the physical classroom environment; the psychological and sociological aspects of that environment; the impacts of that environment on efficient and effective teaching; curriculum; teaching style; discipline management and student and parent preferences. [See Appendix C.]

information provided by the Office of Educational Facilities, State of Florida Department of Education, it was determined that there were approximately 13,000 relocatables being used in all the school districts (this number has since changed based on current information taken from the facility planners' questionnaire). It was assumed that 13,000 teachers were using the 13,000 relocatables, even though some units were used for storage and restrooms. Next, questionnaires were sent to 10% of the 13,000 teachers, approximately 1,300. Districts that had only a few relocatables were not sent questionnaires. The distribution of the questionnaire to the schools was based on schools with the largest number of relocatables in their district, with no school receiving more than 5 questionnaires. Total schools receiving questionnaires was 354.

The questionnaire answer sheet was computer scanned. With the help of the Testing Center at the University of South Florida tabulated responses were acquired for each question and also a breakdown of each district's response. These questions were then cross tabulated using descriptive information in the questionnaire. For example, all questions were scanned using the "grade level" determinant factor. Then, the same scan using the "number of years teaching experience" as a determinant factor was used, and so forth. These various scannings detected trends and inclination that would not be discovered otherwise (see Appendix B).

The total number of questionnaires received was approximately 900. The tables in this report are based on 811 questionnaires.



RELOCATABLES

STATEWIDE

SOURCE: FLORIDA CENTER FOR COMMUNITY DESIGN AND RESEARCH

Figure 1

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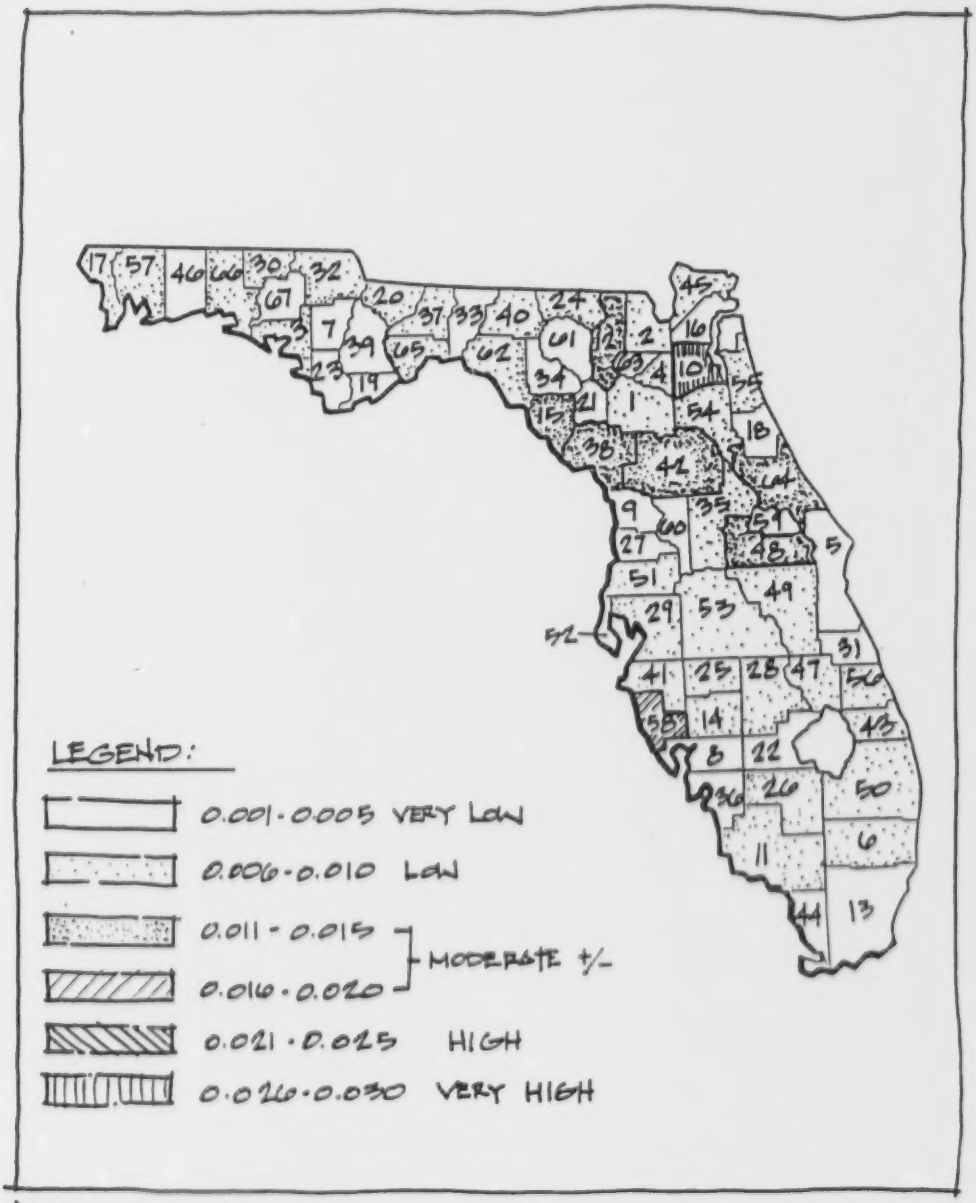

DENSITY

NUMBER OF RELOCATABLES/NUMBER OF F.T.E.

SOURCE: FLORIDA CENTER FOR COMMUNITY DESIGN AND RESEARCH

Figure 2A

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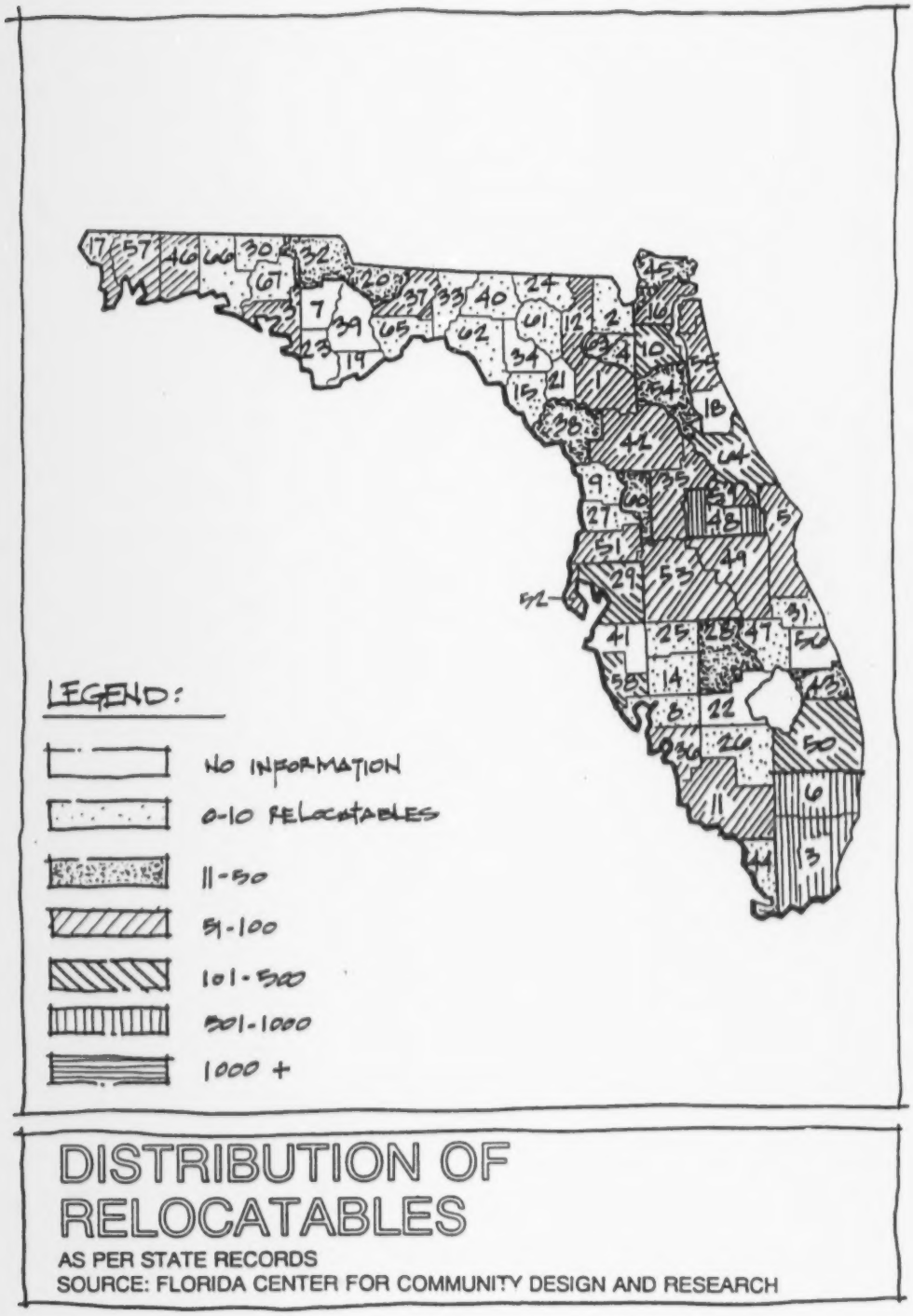

Figure 2B

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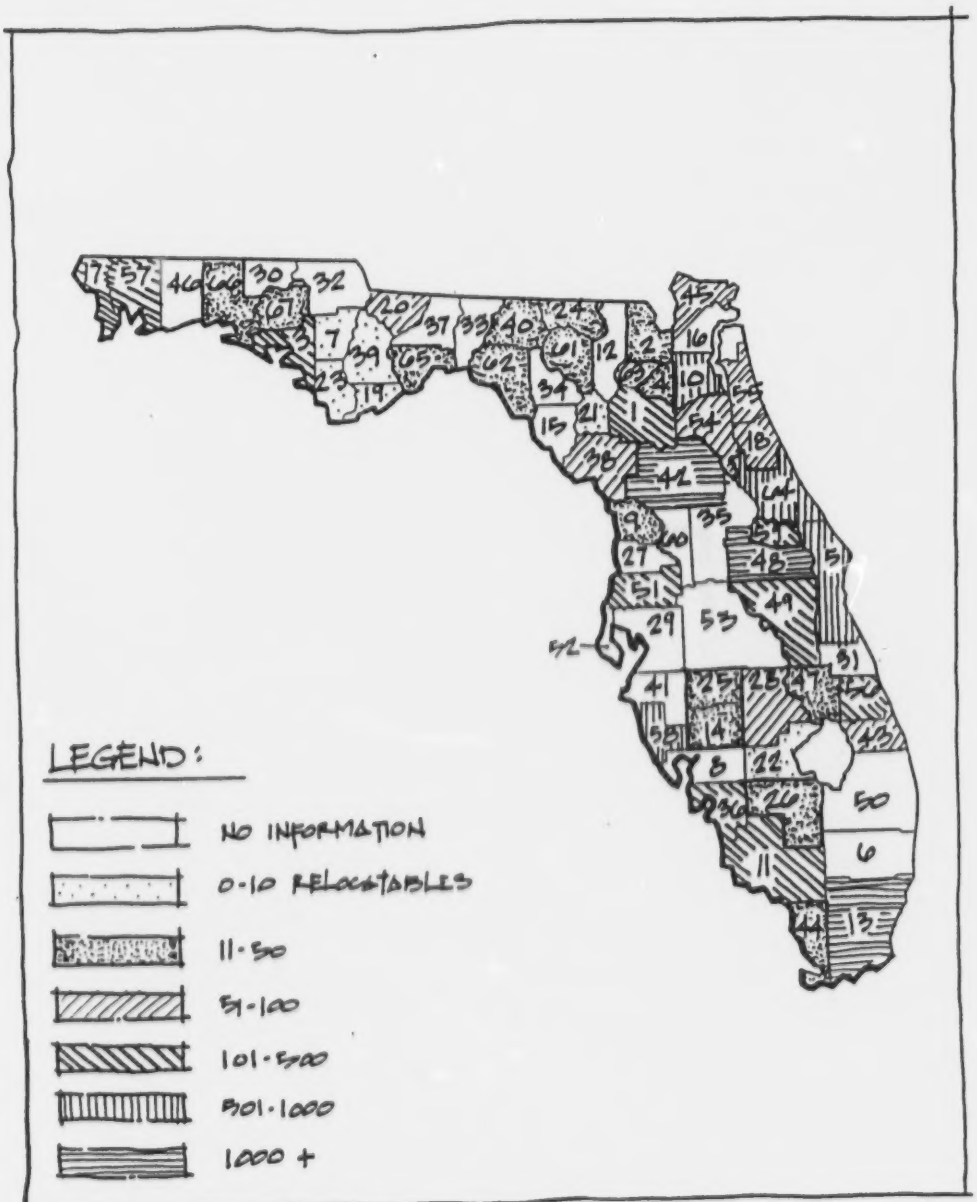

DISTRIBUTION OF RELOCATABLES

FACILITY PLANNER'S QUESTIONNAIRE

SOURCE: FLORIDA CENTER FOR COMMUNITY DESIGN AND RESEARCH

Figure 2C

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Site Visits to Facilities:

This task consisted of a random auditing of school facilities targeted from the teachers' questionnaires. The results obtained from these questionnaires were tabulated as explained earlier, in a matrix format. This matrix generated patterns of approval and disapproval, illustrating the overall teachers' sentiments concerning specific issues (see questions 7 through 40, in Appendix C). This matrix was also effective in rating all the selected counties. In order to obtain a representative sample, three categories were established.

a. The counties with the most positive responses.

b. The counties with the most negative responses.

c. The counties with neutral responses (See Appendix D)

Counties were collected throughout the state that fit into one of the three categories mentioned above. Four general areas were selected: the north east area, consisting of Duval, Nassau, Clay, St Johns, and Putnam county; the panhandle, with Leon county; the central counties, with Marion, Lake, Sumter, Hernando, Orange, Pasco, Hillsborough, Polk, Manatee, Sarasota, and DeSoto; and finally, the southern counties, including Palm Beach, Broward, Collier, and Dade. Twenty three schools in the above counties that were previously targeted for the teacher questionnaires were visited and tested the physical condition of the learning environment using scientific equipments such as light and sound meters. This method of verification results in objective and accurate

data, reducing the possibility of erroneous conclusions that could skew study findings. A survey form was prepared (see Appendix B) that incorporated all the issues relating to the physical environment of the classroom. The survey was organized in several parts:

Safety

Accessibility

Building integrity

Exterior appearance

Site placement issues

Aesthetic issues

Functional compliance

Quality of physical environment

Question to teachers

Meetings with Industry Representatives:

As part of the large spectrum inherent to this study, a meeting with the Modular Building Institute was organized on June 10, 1993 to address all the issues and concerns expressed by the Florida Department of Education. This meeting was also an effort to fill the gap in acquiring knowledge on the manufacturing aspects of these units. After initial resistance from the various manufacturers of modular buildings it was beneficial to be able to meet with the attending manufacturers for an open, objective discussion.

Site visit to Manufacturing Plant:

Local manufacturers of relocatable structures were visited in order to better understand the manufacturing process, as well as its efficiency and cost effectiveness. One of these manufacturers visited was Champion Modular Restaurant Company, Inc., a local successful enterprise in Clearwater, Florida. This visit was enlightening as it demonstrated the efficiency of a system of construction that has been stream lined to save time, generate better products, and greatly reduce construction costs. Champion Modular is still using traditional, conventional construction techniques. Their efficiency relies on the resolution of construction details on the drawing before the actual building process starts. The success of this kind of operation is based on the repetitive, synchronized, and perfected construction schedule. Champion is proud to think of itself as "pioneer in the industry of building robotization." Jerry Ward, General Manager, revealed that "one day Champion will build these units like General Motors builds cars."

Financial Analysis:

This study assesses the financial burdens associated with the employment of relocatable versus permanent classrooms to help alleviate the State's school enrollment problems. The analytical means of comparison utilizes standard net present value accounting based on calculated revenue and cost streams associated with options for the provision of additional classroom space. These options include the construction of new permanent facilities (common classroom additions), the purchase of new relocatable

classrooms, and the leasing of relocatable classrooms. Analyses of each option presents information relevant to both the capital and operating budgets of this state's public educational financing mechanism. While it is true that new additions are normally built in wings of six to ten units and that portables are seldom purchased individually, all analyses are carried on a marginal basis (i.e. looking only at the costs associated with single units as compared to the construction, lease or purchase of multiple units).

Information on the relevant comparative costs, such as initial capital outlays, and operating, maintenance and replacement costs over the expected lifetimes of both permanent and relocatable classrooms has been obtained from a wide range of sources. First, a survey of school district facility planners around the state was conducted, which yielded a wealth of financial information on the leasing, purchase and operations of both types of structures. To collect additional information on specific aspects of operations and maintenance, various school district officials were later interviewed and provided additional information. There was also a great deal of support from the Modular Building Institute (MBI) in supplying current information concerning their products. Representatives of this organization were very open and co-operative in shedding light on a wide array of information deficiencies. A further discussion on the sources of data will be given in later sections viewing the cost and revenue parameters employed.

The first analysis presented is a direct comparison of the purchase cost of a new relocatable versus the construction of a permanent classroom (new addition). Results are based on a range of initial capital outlays for various quality projects and assumptions concerning the costs of capital, expected service lives and operations/maintenance costs.

The second analysis presented is a comparison of building a permanent classroom (new addition) versus leasing a relocatable. Again, there will be a sensitivity analysis over a range of given options. Of particular interest is how the use of various leasing options will likely affect both the operating end of the finance budget and the total lifetime costs.

CHAPTER 4:

Results

A significant part of the relocatable classroom study relied on the results obtained from the facility planners' questionnaire and the school visit surveys. Since facility planners are in constant contact with the daily problems associated with relocatables, their input is invaluable. The staff at the Florida Center reported essential information covering matters such as safety, and general issues. The financial specialist examined all the cost related issues based on information collected from the facility planners' questionnaire as well as follow up interviews with several school district officials.

Facility Planners' Questionnaire

The facility planners' questionnaires were distributed to all 67 school districts in Florida. Fifty seven out of 67 districts have responded to the questionnaire. A narrative summary of their replies is included here. The remaining 10 districts that did not respond were contacted several times by both the Florida Center and the Department of Education requesting their participation in this survey.

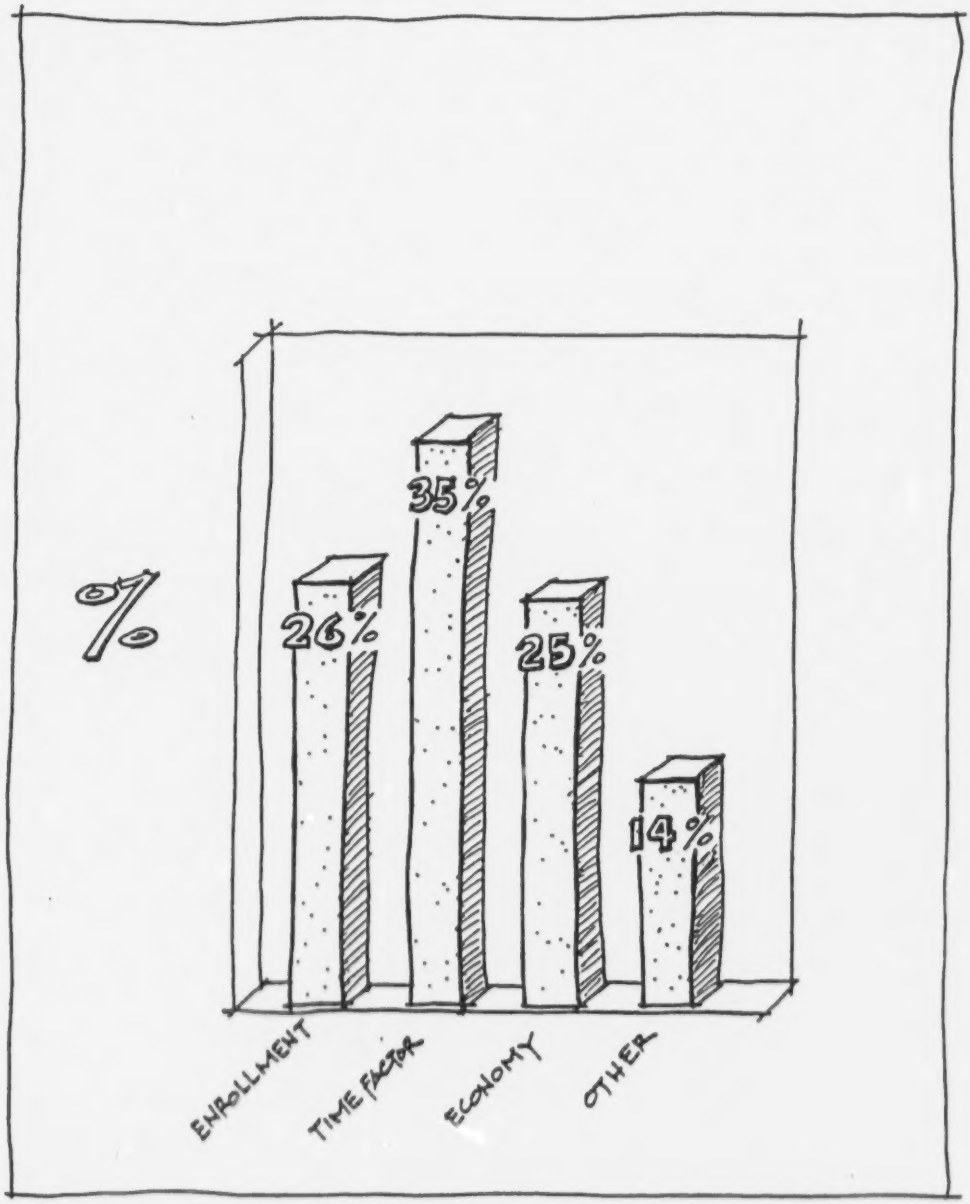
The facility planners' questionnaire contained 58 questions. The questions examined four essential categories: usage issues, cost issues, safety issues, and general information relating to relocatables. The following paragraphs are a detailed account of the survey result.

This section is fairly long and technical. A summary is provided in Chapter 5.

Question 1, What is the reason(s) your School District generally chooses to purchase, construct, or lease relocatable classroom buildings? Shifting enrollments was given as a reason relocatables were purchased by 26% of the districts, time factor (district requires immediate student housing) 35%, economy (relocatables are less expensive than traditional classroom space) 25% and other reasons for purchasing relocatables was 14%. Some of the other reason listed that a relocatable would be used included: grants, renovation, add new programs, and type of funding available. [See Figure 3]

Question 2, Other than relocatable classrooms, what other alternatives has your District considered to meet the requirements described in Question #1? The majority of districts indicated that double sessions, multi tracking or year around school had been considered. Following changes to the school year calendar adding additions, renovating current facilities or constructing new facilities was the next favored alternate plan. Other alternate solutions include leasing buildings in the local community, faster building programs, and shifting school boundaries.

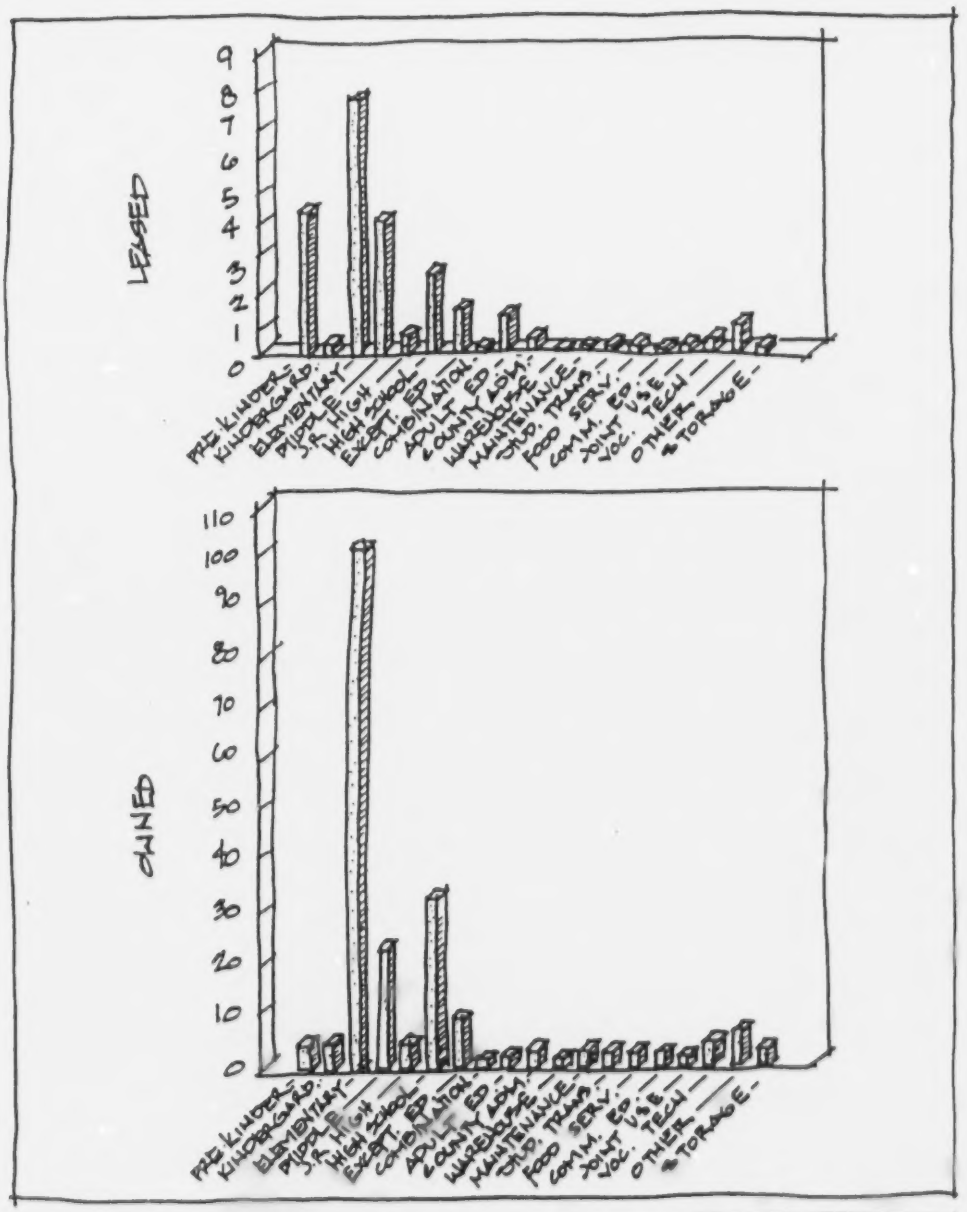
Question 3, requested information on the, location and ownership of all of the relocatable classrooms in your district. The districts completing the table indicated that they collectively used 16,390 relocatable classrooms. The relocatables are dispersed in the following manner: 53% are used by primary schools (pre-kindergarten, kindergarten and elementary schools); 27% are used by secondary schools (middle, junior high and senior high schools); and 16% are used for other academic purposes such as exceptional education, vocational-technical, community education, joint use, adult education, and combination schools. The remaining 3.5% are employed for non-academic uses such as warehouses, maintenance buildings, student transportation, food service, storage and other. [See Figures 4 and 5]



REASONS TO PURCHASE RELOCATABLES ALL THE DISTRICTS IN FLORIDA

SOURCE: FLORIDA CENTER FOR COMMUNITY DESIGN AND RESEARCH

Figure 3

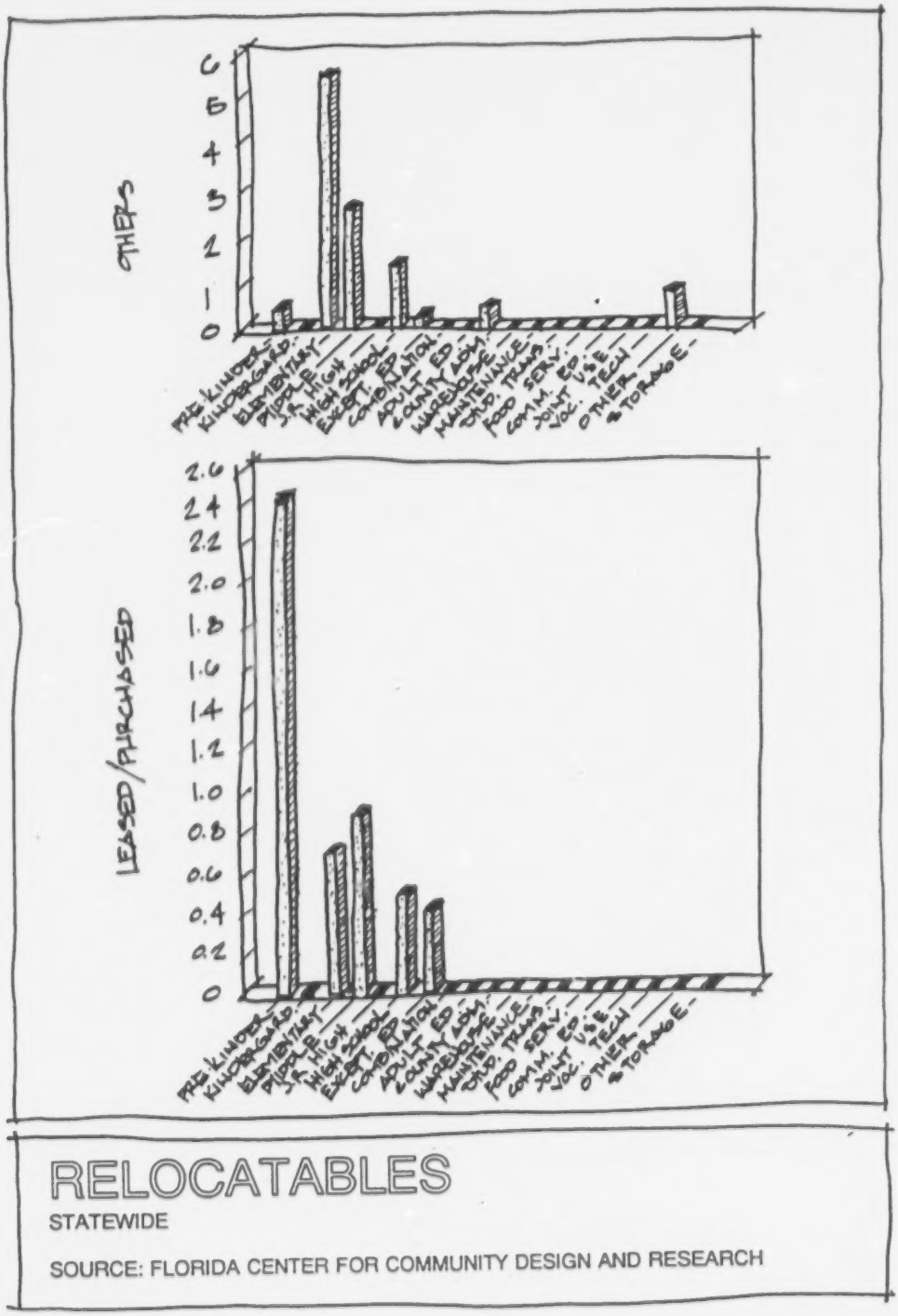


RELOCATABLES

STATEWIDE

SOURCE: FLORIDA CENTER FOR COMMUNITY DESIGN AND RESEARCH

Figure 4



RELOCATABLES

STATEWIDE

SOURCE: FLORIDA CENTER FOR COMMUNITY DESIGN AND RESEARCH

Figure 5

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Ownership of the relocatables is 85% owned, 8% leased, and 7% under lease purchase agreement. [See Figure 6]

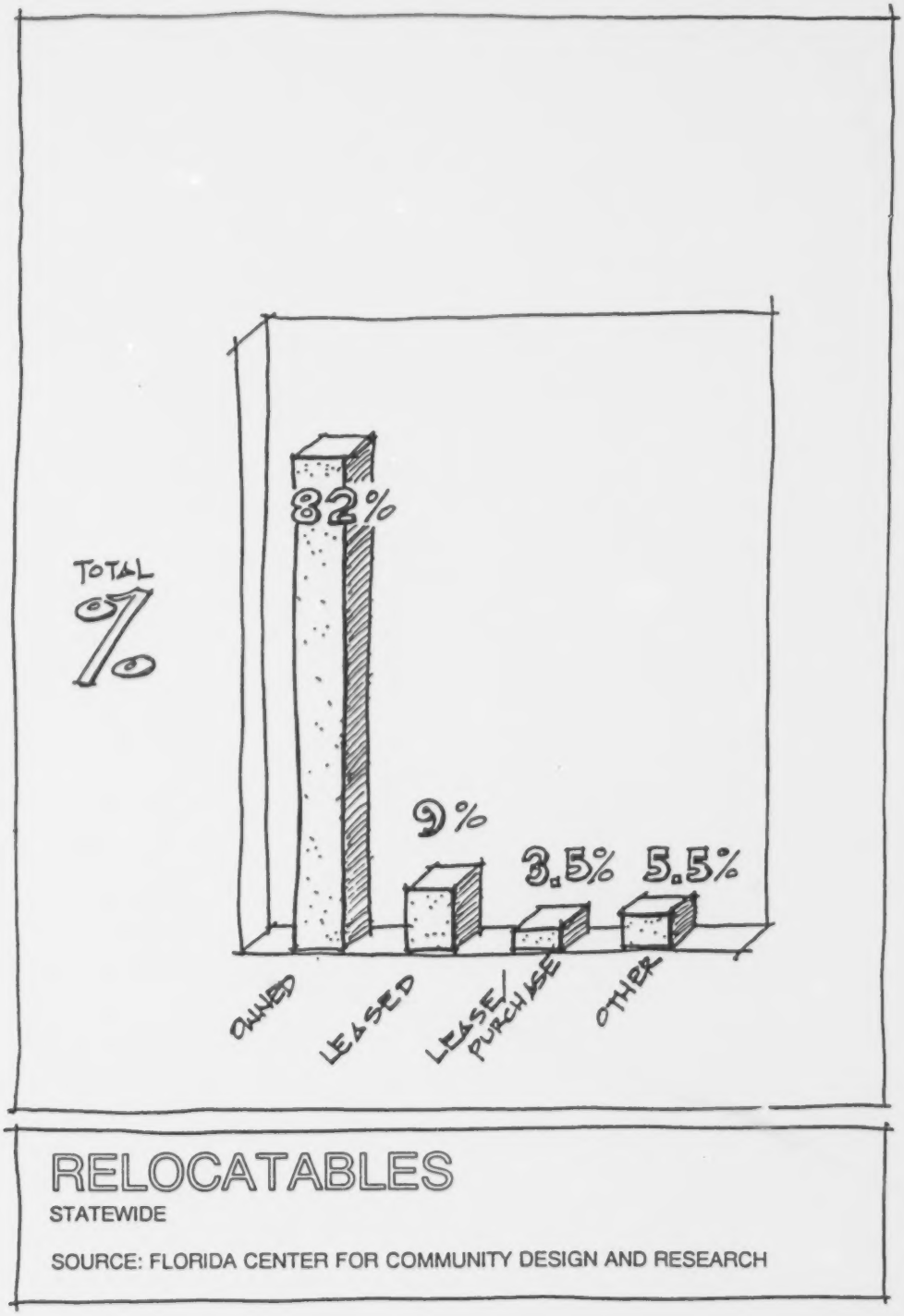
Question 4, How many relocatables does your district have on order, that have not yet been delivered, or under construction, that have not yet been completed? Approximately 170 relocatable classrooms are on order and an additional 185 are under construction.

Question 5, What decision making process is used by your school district when it determines that a relocatable classroom should be bought, leased, or constructed? The majority of districts indicated that cost, availability, timing and number of students are all part of the decision making process in determining the need for relocatable classrooms.

Question 6, What design criteria is used by your school district when selecting a relocatable classroom? There are three main design criteria used when selecting relocatable classrooms: size based on intended use, meet need of education program and meet all 6A-2 requirements.

Question 7, Does your school district use the competitive bidding process when making the selection of relocatable classrooms? Seventy percent of the districts currently use the competitive bid process.

Question 8, Who in your school district makes the final selection of your relocatable classroom buildings? Final selection is made by superintendents and director of facilities in the majority of districts. Other person making final selections on relocatable classrooms include school architect, principal, purchasing department, maintenance supervisor, and the school board.



RELOCATABLES
STATEWIDE

SOURCE: FLORIDA CENTER FOR COMMUNITY DESIGN AND RESEARCH

Figure 6

Question 9, how long (in years and months) does a relocatable classroom remain in use in your school district before it is replaces by another relocatable classroom or permanent construction? The average number of years a relocatable is held in place is 19 years. Thirty percent of the districts hold relocatables for 10 years or less, 38% for 11-20 years, and 32% over 20 years.

Question 10, What method(s) is used by your school district to determine when a relocatable classroom is no longer necessary and should be removed from service? The majority of response indicate reasons a relocatable would be removed from service are: physical condition of unit, decrease in student population, construction of permanent classroom space, cost to renovate relocatable exceeds purchase price of new relocatable, and end of program.

Question 11, What are the specific reasons your school district would remove a relocatable classroom from active service? The responses to question eleven mirrored those to question 10.

Question 12, What method is used by your school district to determine the life expectancy of your relocatable classrooms? The majority of districts use past experience and annual inspections to determine life expectancy of a relocatable classroom.

Question 13, Based on your experience with educational facilities, specifically relocatable classrooms, what factors contribute to making a relocatable classroom stay in use longer that normally expected? Factors that increase the length of use are: preventative and routine maintenance, lack of permanent space, lack of construction funds, and continued increases in enrollment.

Question 14, Does the intended use of the relocatable classrooms in your district change due to the condition of the unit over time? Fifty-four percent of the districts

indicate that the use of a relocatable classroom does change due to the condition of the unit. Forty-six percent of the districts indicated that use did not change with time.

Question 15, How does your school district determine the longevity of permanent classroom space? The responses indicate that there is not a formula used to determine longevity, however districts rely on annual inspections, past experience and the assumption that buildings last 30 to 40 years.

Question 16, In your district, does the use of relocatable classroom space differ from the use of permanent classroom space? The majority of districts indicated that the use of relocatables did not differ from permanent classroom space.

Question 17, At schools where relocatable classrooms are presently in use, how, and to what extent, are the following "core" areas adversely affected by the addition of relocatable classroom buildings to the school site?

Cafeteria. An overwhelming majority of districts indicated that the cafeteria was adversely affected by overcrowding, and a burden was placed on students in relocatables due to the greater distance from the classroom to the cafeteria. Some districts in an attempt to alleviate overcrowding added additional lunch times.

Auditorium. Districts sighted overcrowding and the inability to seat the entire student body at one time. The increased use due to overcrowding increases the wear and tear on the auditorium.

Library. The majority of districts sight overcrowding of the library as an affect of having relocatable classrooms. The library also suffers from lose of scheduling flexibility, book shortages and lack of storage space.

Music and Art Rooms. Districts indicate that overcrowding is the greatest affect on music and art rooms due to relocatable classrooms. In some districts these rooms have been moved to relocatable classroom space.

Faculty/Staff Administration, Offices, Lounge Areas. With the addition of relocatable classrooms districts find the administration areas and lounges crowded, less comfortable and placing increased burden on faculty and staff.

Parking, Vehicle Access, Bus Loading and Unloading Areas. This areas, according to the school districts, become overcrowded causing delays and faculty and staff to park in unpaved areas.

Playgrounds and Recreation Space. The majority of districts indicate that playgrounds and recreation areas become overcrowded with the addition of relocatable classrooms. The playgrounds and recreation areas are reduce when the relocatables are placed on the school site.

Question 18, What is the wear and tear on these "core" areas from the placement of relocatable classrooms at the schools in your district?

Cafeteria. While some districts indicated there is not increased wear and tear as the schools do not exceed capacity, other districts reported increases in maintenance and cleaning problems and increase deterioration due to excessive use.

Auditorium. The auditorium requires extra maintenance and cleaning.

Library. Due to the overuse of this space the library require increased maintenance and cleaning. Items specifically sighted are carpeting and HVAC.

Music and Art Rooms. These rooms according to the majority of districts require increased maintenance and cleaning due to the increased student load.

Faculty/Staff Administration, Offices, Lounge Areas. Increased use of equipment, supplies and increased maintenance of these areas is the most often sighted result of adding relocatable classrooms to the school.

Parking, Vehicle Access, Bus Loading and Unloading Areas. Some districts indicate that there is minimum effect on these areas, while other districts indicate that the overcrowding and increase use

Playgrounds and Recreation Space. The overcrowding of the playground and recreational areas creates unsafe conditions along with increasing the maintenance required for these areas.

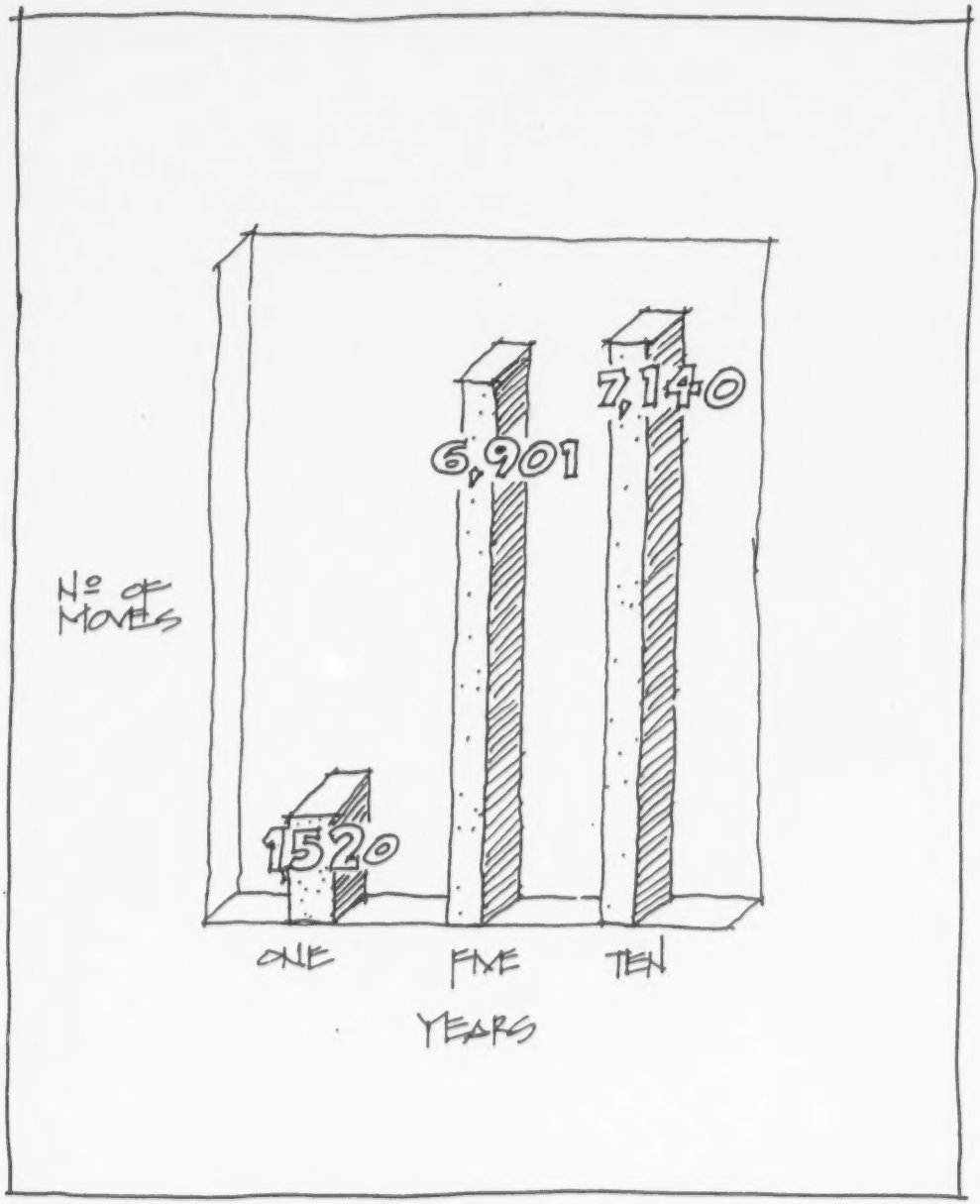
Question 19, What is the overall impact on energy conservation programs in your district when relocatables are added to a traditional school core facility? While responses to the question varied the three primary responses are: conservation programs are compromised as there are inefficiencies in small size electrical; cost is reduced due to manual control; and cost is reduced in the new relocatable because they are more energy efficient than older permanent classrooms and relocatables.

Question 20, How often were your existing relocatable classrooms buildings moved during the following time periods? (Acquiring a new relocatable does not count as a move.)

Over a one year period (1992). 1,520 relocatables were moved by the responding districts over a one year period.

Over a five year period (1987-1992). 6,901 relocatables were moved over a 5 year period.

Over a ten year period (1982-1992). 7,140 relocatable classrooms were moved over a ten year period. [See Figures 7 and 8]



RELOCATABLES

NUMBER MOVED PER YEAR

SOURCE: FLORIDA CENTER FOR COMMUNITY DESIGN AND RESEARCH

Figure 7

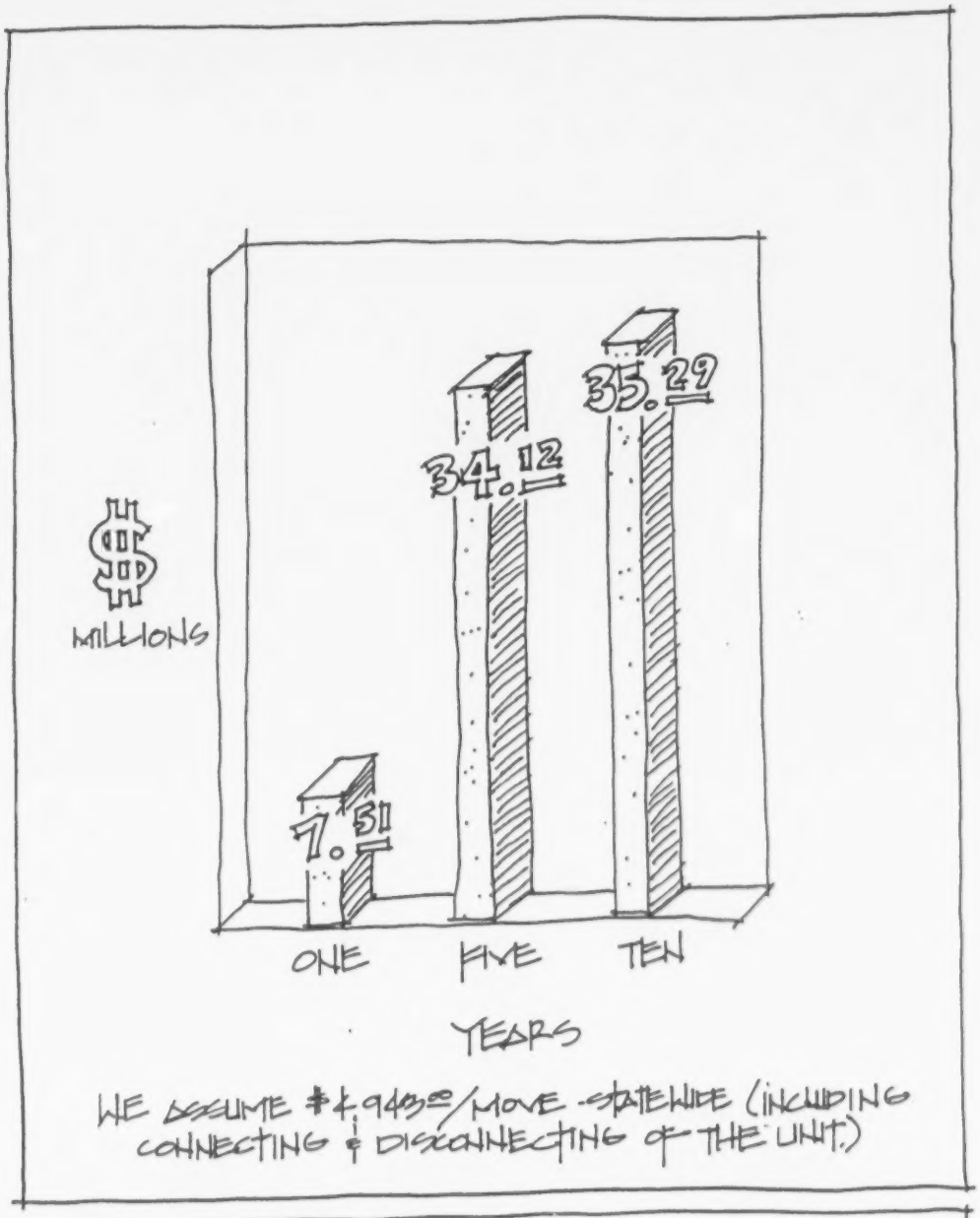


Figure 8

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Question 21, What are the main reasons in your district for moving (relocating a relocatable classroom building? The overwhelming majority of districts indicated that relocatable classrooms are moved to accommodate newly mandated programs and shifts in student enrollment.

Question 22, What is the primary consideration for where a specific relocatable classroom will be placed on a site in relation to existing permanent buildings? The primary considerations for where a relocatable will be placed are: available land and terrain; proximity to core facilities; location of utility connections, adverse affect on play areas; and ease of access by students and faculty.

Question 23, Does terrain of site become an issue in the relocation of portable classrooms? Sixty-eight percent of the districts indicate that the terrain of the site is an issue in the relocation of a relocatable classroom, and 38% indicate that terrain is not an issue.

Question 24, What individual in your district decides the exact location of your relocatables? Seventy-four percent of the districts responded that the principal of the school decided were the relocatable classroom would be place, in 15% of the districts the facilities planner makes the decision, and in the remaining 11% of the districts the superintendent makes the final decision on placement of the relocatable.

Question 25, What are the basic relocatable classroom types (styles) and sizes (capacity) that are used in your school district? The most popular style and size, as indicated by the responses to the questionnaire, is a double wide wood frame on steel.

Question 26, Please list the names of the manufacturers from who you have purchased relocatable classroom buildings. The school districts in Florida obtain their relocatables from the following sources: Gelco, Spacemaster, Diamond Engineering,

Advanced Structures, G.E. Capital, Southern Structures, Modulaire, AZCO Trailer and Williams Mobile Offices.

Questions 27, Please list the names of the companies from who you have leased relocatable classroom buildings. The responding districts have leased relocatables from Space Master, Gelco, Modulaire, Diamond Engineering, G.E. Capital, AZCO, Williams Mobile Offices, Finalco, and Triple A.

Question 28, What is the purchase price, per new unit, for a relocatable classroom by type, model, and manufacturer? Purchase prices on relocatable classrooms range from $7,500 for a 14' x 18' classroom to $46,000 for 24' x 36' classroom. The average cost is approximately $22,000 for a 24' x 36' relocatable classroom.

Question 29, What is included in the initial cost? The majority of responding districts indicated that the initial cost includes the unit, delivery, setup, tie down, and steps.

Question 30, Does the initial cost includes first time set up? Seventy-eight percent of the districts responded that the initial cost does include first time setup, and the remaining 22% indicated that the initial cost does not include first time set up.

Question 31, What is the annual cost of leasing a relocatable classroom by type and model? While response ranged from a low of $2,300 to a high of $17,400 for an annual lease, the average lease rate is approximately $4,500 for a 24' x 36' relocatable classroom.

Question 32, What is the average construction cost for a permanent classroom of similar size? Districts did not have this information available.

Question 33, What polices and/or producers does you school district use for relocating their existing relocatable classroom buildings? While there appears to be no

set policy among the districts, the majority of districts base their decision to relocate classrooms on school need and population shifts.

Question 34, Who moves your relocatables from one site to another? Eighty-five percent of the districts use private contractors 100% of the time to move their relocatable classrooms. The raining 15% either use the school district's movers or a combination of district and private contractors to move their relocatable classrooms.

Question 35, On the average, how far are most relocatables in your district moved at any one time? The smallest distance a relocatable is moved is one mile and the farthest distance reported is 40 miles. The average move is 11 miles.

Question 36, Is the distance of the move a factor in the cost of each move? Of the districts responding 57% indicated that distance was not a factor in the cost of each move. Forty-three percent find distance to be a factor in the cost of each move.

Question 37, What are the transportation costs for:

The initial move? Average transportation costs for the initial move are approximately $1,665.

For subsequent moves? Average transportation costs for subsequent moves are approximately $1,980.

Question 38, How does the type and model of relocatable classrooms factor into the cost of the moving? The majority of districts responded that the larger the relocatable the greater the cost. Also, type of construction was a factor in costs with concrete units costing more to move than wood and steel relocatables.

Question 39, Please provide the following information pertaining to the installation of relocatable classroom buildings in your district?

Cost of site work, surveying, clearing and grading. Average cost $1,433 with the work being performed by school district personnel for the majority of districts.

Foundation costs. Average cost is $341 with work being performed by a private contractor for the majority of districts.

Access: walks, ramps, railing, and service drives. Average cost is $1,028 with work performed by school district or county personnel in the majority of districts.

Electrical power hookup costs including underground installation and exterior lighting. Average cost is $883 with work performed by school district personnel in the majority of districts.

Mechanical hookups including gas lines. Average cost is $218 with work performed being split almost equally between school district personnel and private contractor.

Plumbing hookup including new underground sewer and water and any additional systems required. Average cost is $746 with work performed school district personnel.

Landscaping. Average cost is $153 with worked performed by school district personnel.

Storm drainage and retention area costs. Average cost is $371 with the work performed split equally between school district personnel and private contractors.

Agency inspections. The majority of districts indicated that there were not any charges associated with agency inspections. Those districts reporting a cost for agency inspections reported an average cost of $100. Agency inspections are performed by FDOE, UBCI and Fire Marshall for the majority of districts.

Question 40, What are the types and costs of permits, impact fees and insurance associated with the moving of a relocatable classroom building? All the responding

districts, with the exception of one district, said that all permits, fees, and insurance associated with moving a relocatable was part of the package cost with the contractor. One district reported a $25 fee for a "Permit for Transportation."

Question 41, When required, what are the costs of professional consulting fees for installation of your relocatable classroom units:

Architectural. Of the districts reporting a cost, the low was $250, the high $10,000 with an average of approximately $3,180.

Civil Engineering. Only one district reported a cost of $500.

Structural Engineering. No costs were reported by the responding districts.

Mechanical Engineering. No costs were reported by the responding districts.

Electrical Engineering. Only one district reported a cost of $750.

Question 42, Does your district UBCI (Uniform Building code Inspector) inspect the installation of all relocatable classrooms in your district? Seventy-seven percent of the districts have inspections after the installation of a relocatable. The remaining 23% of the districts do not have inspections. The reasons that not having inspections include: district does not have one, inspectors have not had the time to inspect them due to load, function performed by state licensed building contractor, and architect has UBCI person.

Question 43, Please provide the following information pertaining to the detachment of relocatable classroom buildings in your district?

Cost of disconnecting electrical power. The average cost is $311 with work performed by school district personnel in 75% of the district and by the power company in the remaining 25 percent.

Cost of disconnecting gas service. The average cost is $259 with the work performed split almost equally between school district personnel and gas company.

Cost of disconnecting sewer and water. Average cost is $193 with the work performed school district personnel in the majority of districts.

Cost of structural detachment. The average cost is $384 with the work being performed by school district personnel in the majority of districts.

Are existing foundations reused or destroyed? Eighty-six percent of the districts reuse the existing foundations. Fourteen percent of the districts destroy or do not reuse the existing foundations. Reasons for not reusing existing foundations are because they are poured or due to safety requirements.

Cost of clearing the area for transportation. The average cost is $277 with the work performed by private contractor in the majority of districts.

Cost of redeveloping the site once the relocatable units are gone. The average cost is $602 with work performed by school district personnel in the majority of districts.

Question 44, Does your district have a maintenance staff dedicated solely to relocatable classrooms? If yes, what is their yearly budget for repair and maintenance? Only 4 districts indicated that they had maintenance staff dedicated solely to relocatable classrooms. Of those two districts reported annual budgets of $1,112,918 and $723,000.

Question 45, Please provide the following information and the cost associated with each operation pertaining to the ongoing maintenance of your relocatable classroom units.

Cost of keeping units clean. Average cost is $1,166. Two districts reported a district budget of $58,175 and $25,000 for this item.

Cost of repairs to the structural and support systems. Average cost of $504.

Cost of repairs to the exterior finishes. Average cost of repairs is $1,045.

Cost of repairs to the interior finishes. Average cost of repairs is $1,540.

Cost of repairs to the electrical systems. Average cost of repair is $224.

Cost of repairs to the mechanical systems. Average cost of repairs is $1,079.

Cost of repairs to the plumbing systems. Average cost of repairs is $296.

Cost of repairs to the roofing systems. Average cost of repairs is $ 1,615.

Question 46, How do theses repair costs compare to permanent classroom buildings? The majority of districts indicated that the cost of repairs for a relocatable classroom were higher than those for a permanent classroom. Some of the reasons sighted are: type of construction materials used; higher incidence of vandalism; and more repairs for interior and exterior wall finishes.

Question 47, What are the utility costs associated with operating a relocatable classroom building in your district? The average annual costs are: lighting and school equipment $380; operating heating and cooling equipment $642; mechanical $28; sewage charges $26; and water usage charges $106.

Question 48, How has your relocatable classroom buildings endured server weather condition such as tornadoes, hail storms, heavy rain, and hurricanes? Overall the districts reported that relocatables performed adequately during sever weather. Dade county sighted that the newer relocatables performed with less damage that expected. A few districts did indicate that their relocatables were instable during severe weather and suffered roof damage due to high winds.

Question 49, What is the severity of damage that has occurred? Almost all the damage reported was to the roofing system. As a result of this damage units have suffered interior leaks and water damage to exterior skin.

Question 50, How does the damage that occurred to your relocatable classrooms compare to your permanent classroom buildings? The majority of districts indicated the damage was comparable or only slightly higher in relocatables than in permanent classrooms.

Question 51, What was the cost of repairing your relocatable classroom buildings that occurred from intense weather conditions? The costs reported for this question range from $25 per unit, $5,000 per year to $1,000 per occurrence.

Question 52, In your school district, has there ever been loss of life, injury, or severe damage as a result of a fire in a relocatable classroom building? If yes, please explain. Only seven districts had a yes response to this question. Of those that responded yes, there were no occurrences of loss of life or injury. All facilities were unoccupied at time of fire. Only one district reported more than one occurance of a fire to a relocatable. Total relocatables destroyed by fire were 8. Arson was and maintenance were reasons some gave for fire.

Question 53, In your school district, has there been loss of life or severe injury to a student, faculty or staff member, or visitor that can be directly associated with a relocatable classroom? If yes, please explain. All districts reported no incidents directly related to the relocatable classroom.

Question 54, How do you dispose of a relocatable classroom building when it is no longer of use to your school district? The most popular means of disposal are demolition, selling, conversion to storage space and fire department training.

Question 55, Where do you store extra (surplus) relocatable classroom buildings? While the majority of districts did not have any surplus units, those that did prefer to store them on the school grounds were the relocatable was last used.

Question 56, What are the costs involved with the storage of the extra (surplus) relocatable units? As the vast majority of these units are stored on the grounds of the school last utilizing the unit there is virtually no cost for storage. Districts that move the units to a district facility report storage costs of approximately $312 per month.

Question 57, How do you presently mark or identify each relocatable in your district for inventory/tracking purposes? All districts currently use the F.I.S.H. numbering system to identify their relocatable classrooms.

Question 58, What fund source(s) has been used by your district to pay for the purchase, construction or lease of relocatable classrooms? Based on the responses the most popular sources of funding are: Federal, Local Discretionary Millage and PECO/Unit Allocation 235.435(3) F.S.

Site Visit Survey

The site surveys that was made indicated that 50% of the structures were placed with less than 15'-0" between units. The Rules of Florida, State Board of Education, for Educational Facilities, Public Schools, and Community Colleges, Chapter 6A-2, Florida Administrative Code, of 1986, states that "Relocatable buildings shall be separated from each other and any permanent buildings by sufficient distance in each direction to prevent spread of fire and to allow fire fighting equipment access to all buildings." Chapter 6A-2 does not state a specific distance, however, Hillsborough county, for example, has determined 15'-0" as a minimum distance (this distance allows for a firetruck driving

through as well as firemen working on either side of the firetruck). The 15'-0" distance was assumed to be the cut off line in this survey. A relocatable with non-combustible construction can be located closer if there are no penetrations (windows or doors) and walls are properly fire rated.

Regarding access to the relocatables and the condition of the walkways, 66% of all walkways we surveyed that lead to a relocatable were free of cracks, settlement, and uplifts. 88% of all the relocatables surveyed had stairs properly attached and 80% had adequate treads and risers (max. riser 7"; max tread 11"). Of all the units surveyed, an overwhelming 92% had a crawl space. The remaining 8% were slab on grade. Only 19% of all the units had a protective skirt, however, 84% of the crawl spaces were free of debris. Out of the units that had a crawl space only 2% were burned.

Accessibility. All the relocatables surveyed, without exception, had two means of egress, but only 48% had passageways accessible to persons with disabilities. Concerning the safety of the stairs, only 44% had uniform riser height and tread width; 83% of the risers were open and 78% of all the relocatables had handrails on both sides. Fifty four percent of all the units had a ramp system for users with disabilities; 5% did not have adequate fire extinguishers, and 43% had adequate visual and audible alarms.

Building Integrity. The units surveyed ranged in age from three to fifty years. Maintenance is a more important issue here than age per se, as the overall condition of the building and its integrity as a safe and aesthetically pleasing structure depends on regular maintenance and the skill of the maintenance crew. Sixty percent of the relocatables surveyed were well maintained. [See Figure 9]

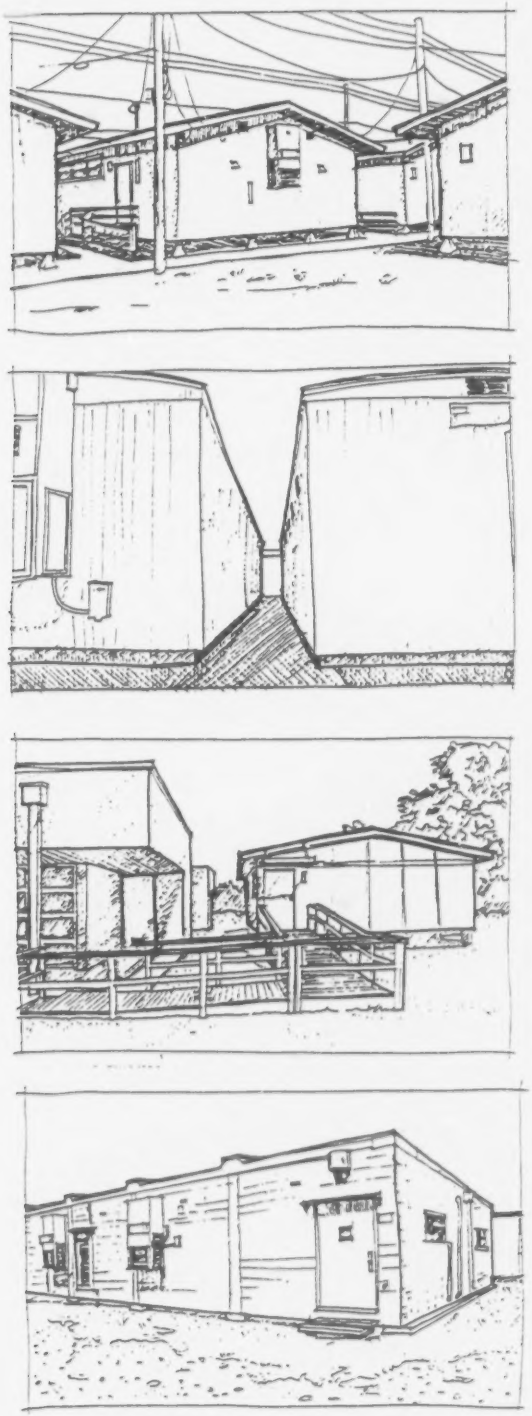


Figure 9

Exterior Appearance. The type of foundation most often used is concrete masonry unit (CMU) on pad. Another type of foundation commonly used is precast pier on pad. The least used type of foundation is continuous footing as well as heavy timber on pad. Regardless of the foundation type, tie downs must always be used with manufactured structures. The survey results indicate that 84% of all the units had tie downs; however 62% of these units were not correctly secured. The floor structure in 74% of the cases was wood. Twenty one percent had steel floor structures, and 5% were concrete slab on grade. The exterior finish on 60% of the surveyed structures was wood siding, 30% had of metal/aluminum siding, 9% were built of concrete masonry units, and 1% had a stucco finish. The main roofing systems were 56% shingles, 32% single ply, 9% aluminum, and 3% using felt and aggregate. [See Figure 10]

Site Placement Issues. The Center determined that the layout of the relocatables was poorly planned at 63% of the schools visited. This observation was based on the overall arrangement of the relocatables within the school grounds as well as the relationship between the school core and the relocatables. Five percent of the schools had misplaced sidewalks left from previous layouts. Sixty four percent lacked any kind of landscaping material or grounds beautification. [See Figure 11]

Aesthetic Issues. The core, permanent structures of the schools surveyed were found to be comparable in aesthetic appearance to their neighboring communities. On the other hand, only 38% of the relocatables were aesthetically comparable to the -school core. Comments from the Center's survey staff were generally negative. These reports show that many of the units were dirty, mildewed, weathered, and even warped. Exposed utilities and overall poor conditions characterized most of the units. [See Figure 12]

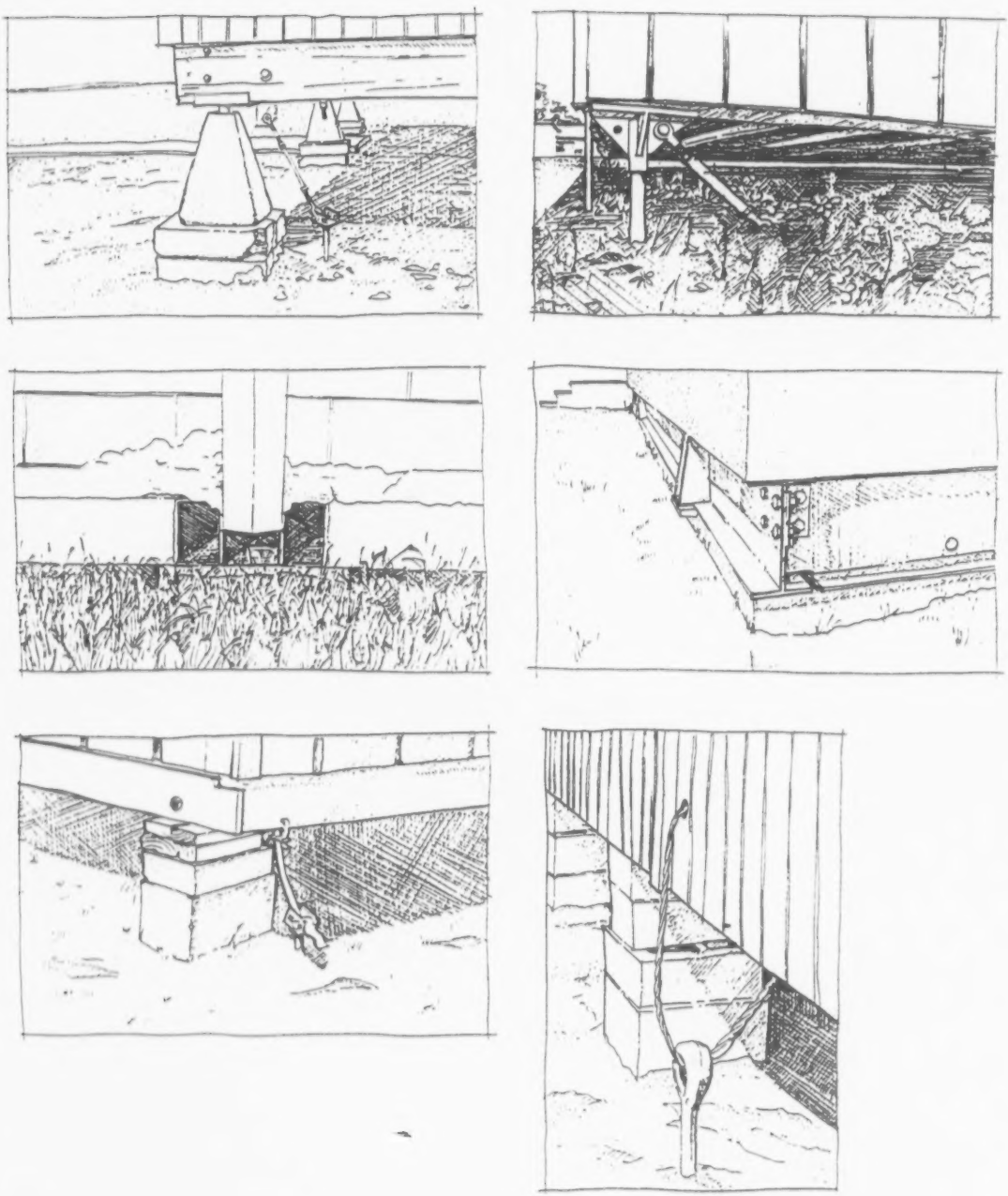


Figure 10

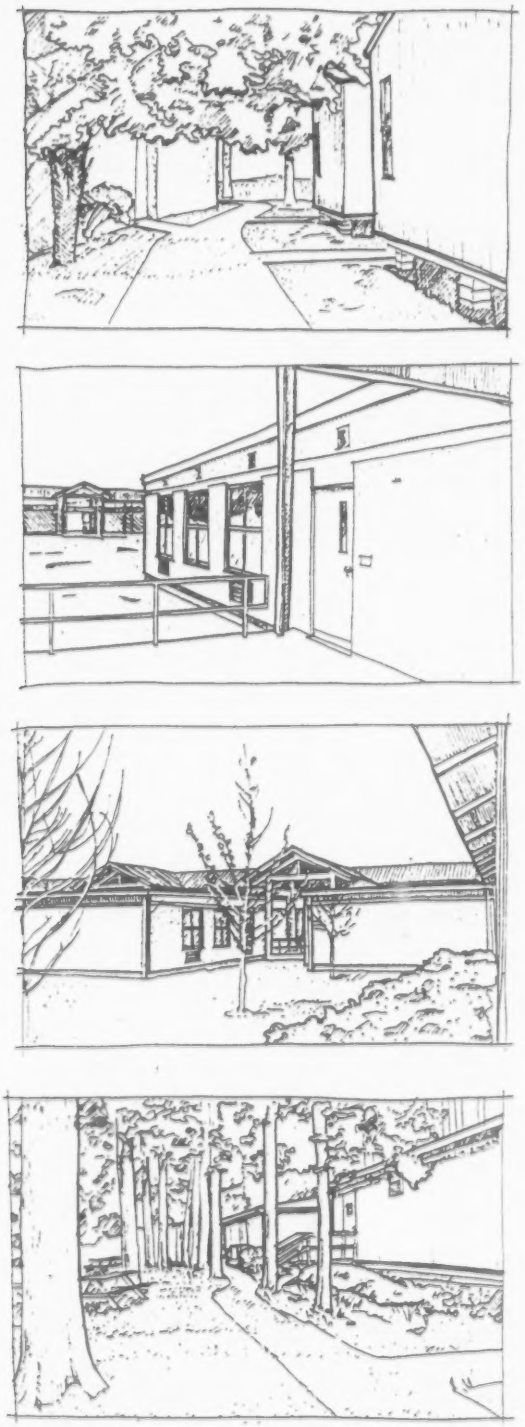


Figure 11

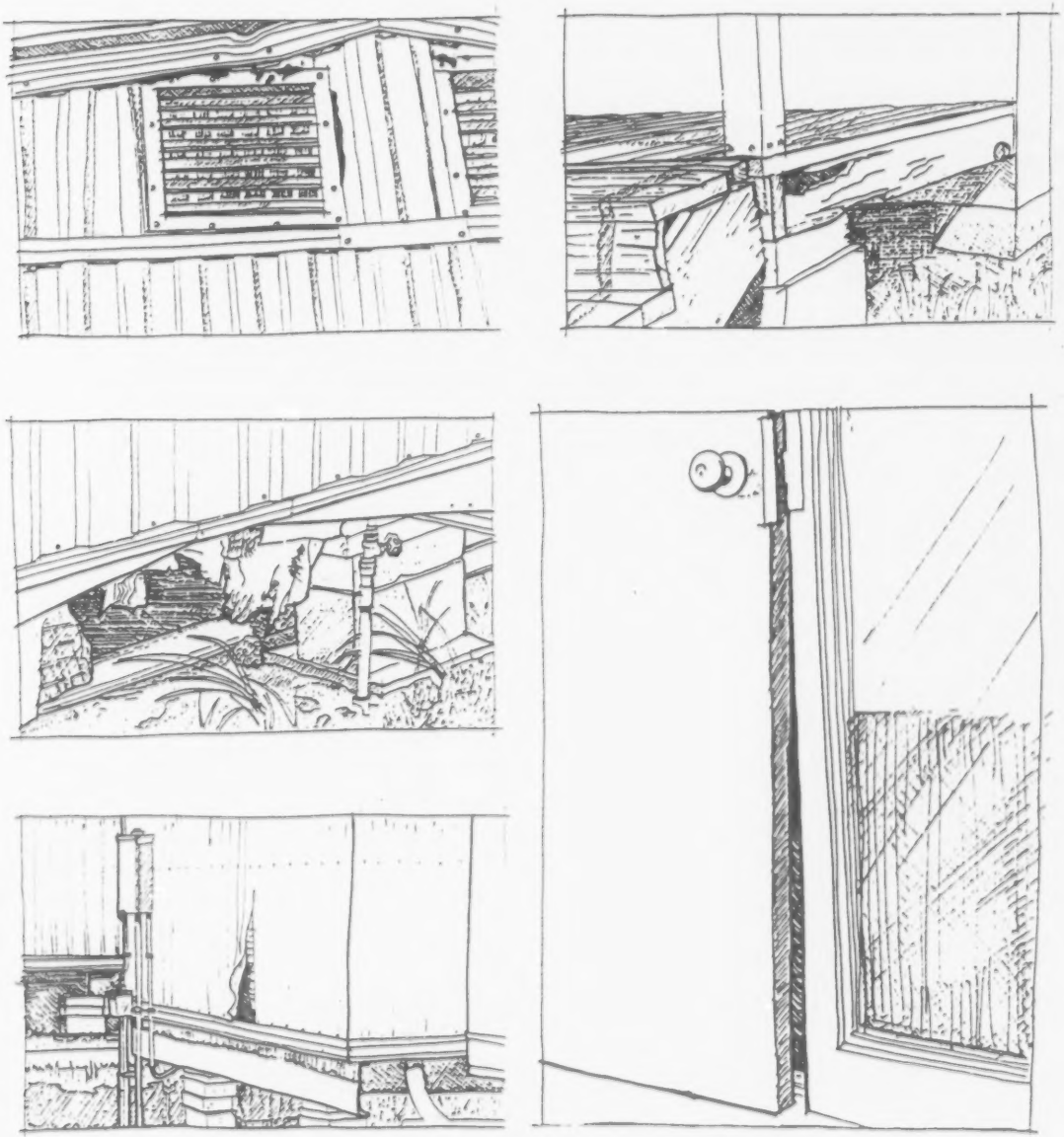


Figure 12

The next segment of the field surveys studied doors, windows, floors and walls. Eighty-eight percent of the units surveyed had adequate doors and windows and 95% were working satisfactorily and only 3% of the doors had air leaks. Ninety-three percent of the doors conform to Life Safety requirements and few were found obstructed with furniture and other equipment. All the relocatables surveyed had windows of varying sizes and types. None had developed any air leaks, and 83% of the windows were operable. Seventy-nine percent of all the units surveyed had carpet, 16% had vinyl, 2% had exposed concrete slab, and 2% had hardwood floors. All the floors surveyed were structurally firm, stable, and had slip resistant surfaces. Eight percent of the relocatables did not have joint plates between sections lay flat against the floor. Regarding interior walls, 71% had pre-finished plywood paneling, 16% had vinyl wallcovering, 7% had painted/drywall, 2% were composed of concrete blocks, and 4% were made of other types of materials. As a general case the pre-finished paneling needed minor repairs. A large number of the relocatables had paneling pulling away from the wall. Many of the units needed holes patched and a fresh coat of paint. Forty-six percent of the walls were light colored, 40% were considered medium in color, and 7% were too dark. One-hundred percent of the ceilings were made of acoustical tiles.

The ceiling heights ranged from 7'-9" to 9'-6'. Chapter 6A-2 requires a floor to ceiling to be 8'-0". The color of the ceilings overall was white. Fifty-eight of the ceilings had stained or sagging tiles. Many of the classrooms were missing ceiling tiles.

Functional Compliance. Out of the units surveyed, 23'x32' is the most popular size. This proportion is a logical choice for a classroom as the relationship between the length and the width of the building determines the classroom layout and enhances the learning process.

Of all the units surveyed, 61% did not have adequate storage and 38% had no bathroom. Among the 62% with a bathroom, 30% complied with ADA (American Disabilities Act) requirements. Eighty percent had adequate ventilation in the bathroom and 78% met 6A-2 requirements.

Quality of the Physical Environment. Chapter 6A-2 states that "Illumination in single classroom may be designed to provide an average of seventy (70) footcandles glare free at normal task level. Fixtures shall be so located that there will be uniform illumination in all parts of the space." The survey indicates that 66% of the classrooms inspected had less than seventy (70) footcandles on the surface of the desk; and 100% had less than seventy (70) footcandles on the surface of the chalkboard.

Natural light: Since most of the relocatables surveyed were different in shape, size, and construction type, the system of openings in the units varies greatly. Chapter 6A-2 requires a minimum of 1,296 sq.in. of natural light for a single classroom unit to prevent panic in the event of a power failure. The units surveyed ranged from one (1) window to eleven (11) windows. Only a few did not meet 6A-2 requirements.

Sound: A range of decibels were recorded with the air conditioning unit switched on. The relocatables have between one and three air conditioning units. The range in decibels was dependent on the type of unit, its power, and its installation. A maximum of 80 decibels and a minimum of 42 decibels were recorded. The Architectural Graphics Standards (Ramsey & Sleeper, 1988) recommended range for background noise in the classroom is NC 30-35 at a frequency of 1000 Hertz. The NC 30-35 for acceptable standard continuous noise is 37 decibels. The background noise measured in all the classrooms visited was not in the acceptable range.

Air quality: Eighty six percent of the units had enough fresh air intake; however, 23% had disturbing odors such as mildew, old carpeting and toilet odors.

Questions to Teachers. Of the teachers surveyed, 25% had disciplinary problems in their classroom. The Florida Center attributed this problem to the high level of background noise reported earlier. Most teachers were satisfied with the distance between the relocatable and the school core. Nearly all of the teachers stated a desire for covered walkways, more storage space, and larger relocatables.

Financial Analysis

Present Value Discounting. When performing any type analysis which involves costs or revenues which are expected to accrue over time, the streams must be made comparable by expressing them in present value terms. There are two ways of setting up the discounting factors to arrive at present value. In the first case one can use a discount factor based on a "nominal" or current interest rate, which is a non-inflation-adjusted measure of the cost of capital. This rate is appropriate if the series which is being discounted suppose a certain rate of inflation for the period of analysis. On the other hand, to make things easier one can simply use a "real" inflation-adjusted interest rate in the calculation of the discounting factor and apply the resulting factor over the given (non-inflated) cost or revenue stream. In this analysis we have chosen to use the second method with the "real" interest rate being the difference between the current yield on 20 year municipal bonds and the current rate of inflation. We will include a sensitivity analysis across various rate levels in each of these determinants employed in the calculation of a discount factor.

Cost Items. The costs associated with each type of project may be separated into four distinct categories: initial capital outlays, operating, maintenance and replacement costs. A description of each of these categories, how the relevant data were obtained and what the costs are for each of the facility types is given here.

Initial Outlay/Capital Costs: These consist of the initial expenditures necessary for the purchase of a new relocatable classroom or the construction of a "common" classroom addition at an existing site. Over the course of the collection and analysis of information relating to the direct capital costs of the two types of physical structures there has been substantial effort to assure that all relevant factors affecting unit costs have been included.

Estimating the expected costs of a "common" classroom addition has posed some problems in this analysis. It was initially thought that the use of readily available contract cost data for new plant construction could be used as a proxy, but upon further review it was determined that the inclusion of core facility costs within these figures would upwardly bias the estimates. Data on addition costs have been collected from a small sample of Florida districts that had recently completed new additions and an average of the available "contract" cost figures has been computed for use in this analysis. The "contract" costs used contain only direct construction costs and the costs of any included permanent attachments such as blackboards, lighting fixtures, climate control equipment and floor covering.

So as to account for all expenditures encountered with the construction of a new addition the associated costs for legal, administrative, architectural and engineering services as well as site improvement costs have been added to the "contract" costs explained above. These figures are computed as percentage contributions above baseline

square foot "contract" costs and are founded on statewide average full-facility rates, as reported by the Florida Department of Education. Estimates of both "contract" and "total" square foot costs for the construction of "common" classroom additions are given below along with a breakout of the contributions of included associated costs as a percentage of "contract" square foot costs.

Associated Cost Additions to "Contract" Construction Costs

of New Common Classroom Addition

Fiscal Year 1991-92 Average Rates

Estimated Contract Cost		
Per Square Foot		$54.80
Legal & Administrative	2.34%	
Architect/Engineer	5.30%	
Site Improvement	3.10%	
Total Square Foot Cost		**$60.70**

Table 1

Information regarding purchasing costs for various types of relocatable units was obtained from survey responses and personal interviews with both district level officials and manufacturers representatives. Consistent information on these was difficult to obtain. Due to the fact that there are many different sizes and amenity options and combinations available for today's relocatables there was a wide range of costs reported. Employing averages of the available data, a range of likely purchase prices was

established within a range of $22-29 per square foot for a basic "no frills" unit, $30-37 for a medium grade unit and $38-47 for a high end unit. These costs generally include initial moving costs from factory to site.

Operating Costs: These costs consist of recurring annual expenditures on electric power for normal operations. Unfortunately, the survey response data was not particularly helpful in deriving estimates of comparative energy efficiencies across the two alternative structures. Instead of quantitative comparisons respondents typically gave anecdotal comparisons of their subjective views on energy usages across facility types. Do to a lack of information we use figures from a September 1992 report by the School District of Flagler County, "Analysis of Alternative Uses of Permanent and Relocatable Construction," as a basis for comparison. This report estimates that permanent classrooms use approximately 10 KWH of power per square foot annually and that low cost relocatables use 14 KWH per square foot annually while upper end relocatables use 12 KWH per square foot.

One problem with the KWH usage figures for relocatable classrooms is that they are based to a large extent on experience with older units which are probably less efficient than newer units due to technological changes (better insulation and more efficient HVAC units) which make today's relocatables much more efficient than their predecessors. For the purposes of this report an annual KWH usage figures of 11 KWH per square foot for middle and upper end units and 12 KWH per square foot for low-end basic units is used.

Maintenance Costs: This category includes recurring costs associated with the normal maintenance schedule for schools. Again due to a shortage of available data, for the purposes of this analysis information contained in the earlier mentioned report by the

School District of Flagler County (1992) will be employed to determine a schedule of average annual maintenance costs. According to that report the level of expected maintenance costs on an annual per square foot basis runs approximately $2.30 for permanent structures, $2.88 for middle and upper-end relocatables and $3.22 for low-end relocatables. Based on the results from the facility planners' survey it is felt that these numbers should be tempered somewhat to reflect the information contained in the responses.

Evidence from the survey data collected shows that 61.9% of the respondents felt that relocatable classroom structures had the same annual maintenance costs as permanent structures, while 23.8% felt they were higher and 14.3% felt that they were lower. To take this information into account we will use the figure of $2.30 as the expected cost for permanent and then provide analyses in which annual maintenance costs per square foot for relocatables are set equal to the permanent costs and then with costs running at $2.75 for low-end models and $2.50 for middle- and upper-end models.

Replacement Costs: Items covered in this category include the periodic replacement costs associated with HVAC systems and roofing for each facility type. They also include costs for periodic relocatable refurbishment. With respect to the replacement costs of HVAC systems, information on expected service life and unit cost were obtained from the 1991 A.S.H.R.E. Manual and 1993 R.S. Means Mechanical Cost Data Manual.

For permanent additions it has been assumed that each unit would be tied into a central centrifugal chiller unit for which A.S.H.R.E. estimates show a median service life of 23 years. To arrive at a per-addition cost of a new chiller system, the price of a 400 ton

system ($155,600) was divided by 133.33 to account for the fact that it takes 3 tons to adequately control the climate of 1,000 square feet of space (133.33=400/3). This produces an expected cost of $1,167. The figure includes both physical unit cost and necessary labor. Added to this figure is an estimated cost of $500 for necessary air-handling equipment, giving a total HVAC replacement cost of $1,667 for a permanent addition. According to the same source of information, the package terminal air conditioning units employed on most relocatable classrooms have an expected service life of 15 years and a unit cost of approximately $2,775.

Based on interviews with school district planning officials it is assumed that both permanent and relocatable classrooms will need refurbishment once every fifteen years of service to meet state requirements. The estimated costs of refurbishment currently stand at approximately $4,000 for a permanent classroom and $9,000 for a relocatable. These costs include necessary improvements to both interior and exterior physical structures and amenities.

Expected Service Life of Physical Structures. Information from the surveys sent to district level school officials indicate that respondents expected a service life of 40 to 50 years for a permanent addition and 23 years for a relocatable. Many respondents reported having permanent school structures as old as 100 years and having relocatables that have been in use for more than 40 years. For the purposes of this study it is assumed that a permanent addition will have a useful service life of 50 years and that newly constructed relocatable classrooms will have a useful service lives of 30 years for low-end units and 35 years for mid-and upper-range units.

The life-cycle period for analysis will be established at 30 years as any costs associated with operations past this point would make up only a very small proportion of

total costs after discounting. This break point is also convenient for the purposes of accounting for any residual value to the structures as the low end relocatables will be at the end of their service life at this point and will thus have no residual value to account for. To determine the residual value of a permanent addition or a mid to upper end relocatable at the end of the life cycle a straight-line depreciated value of the initial cost is attached in the final year of analysis.

Relocatable-Specific Costs. Since relocatable classrooms can be moved from site to site there are moving costs associated with their ownership which do not exist for permanent structures. The mobility is certainly seen as an asset by district planners and is a major reason that relocatable classrooms are becoming so popular. With unpredictable shifts in enrollments rising, relocatable classrooms offer a great strategic advantage over permanent structures in alleviating short-term accommodation problems. Each fall local officials scramble to accommodate unexpected enrollment levels in some schools and experience unexpected shortfalls in enrollments in others. This intra-district mismatch in enrollments leads to a need for quick solutions which relocatables provide.

Of course there are associated costs every time a relocatable is moved. These costs can generally be categorized into three distinct elements: direct physical moving costs, disconnection costs and connection costs. According to information provided by respondents to our district surveys; the average physical moving costs run approximately $2,068, average disconnection costs run approximately $600, and average connection costs run approximately $2,275. Summing these yields an average total relocation cost of $4,943.

A problem is how to account for these costs on an annual basis in a comparison of the life-cycle costs of permanent and relocatable classroom structures. In order to

assure that the comparison is carried out on an apples to apples basis, moving costs will not be included in the initial estimates of relative life cycle costs associated with each type of structure. Initial costs/fees for utility connections and site improvement will be included during the first year as they are a necessary cost of service provision. The logic behind this decision stems from the fact that a relocatable is indeed also a permanent structure until the decision is made to move it.

While moving costs associated with relocatables have no effect on district capital budgets, they do have very important implications for the operating budget. In today's budget setting, with most Florida school districts topped-out on taxing capacity, and with Amendment 10 restrictions to growth in their local tax bases, any factors raising the cost of annual operations funds merit serious attention.

Effects of the Use of Relocatables on Operating Budgets. There are two distinct areas in which relocatable classrooms impose additional costs on annual operating budgets as compared to permanent classrooms. The first and most obvious costs occurs because of the inherent nature of their use: they are adopted most often for the short-term accommodation of shifting school enrollments. As described in the methodologies section, even when the district owns the relocatable, shifting demographics means moving the relocatable, and the moving costs associated with relocating a relocatable are sizable ($5,000). Of course these costs only occur if the relocatable is indeed moved.

While these costs may not seem large when viewed on an individual basis they accumulate rapidly when there is a large number of relocations being made. For instance, there are approximately 16,000 relocatable classrooms in use in the state of Florida. If each of these units were moved on average once every two years the annual average moving cost alone would be $40,000,000.

The second area in which these units in our additional cost is in their operation and maintenance as compared to permanent structures. If it is assumed that the annual operating costs of a relocatable are $1,200 and that the annual maintenance costs run $2,750, the combined costs are approximately $650 above the related figures for a permanent facility. Based on 16,000 units operating in the state at present this difference represents a $10.4 million annual additional cost. This is enough to build 147 permanent classroom additions.

The above analysis should assist district leaders in understanding the trade-offs associated with the use of relocatables. The use of these structures around the state plays a very critical role in accommodating school enrollments but also places additional strains on already tight operating budgets.

Results. Within this section the results from the life cycle cost analysis comparing the expected costs over a 30 year period for conventionally constructed permanent classrooms and relocatable classrooms are presented. As described earlier in the methodology section this analysis has been conducted on a marginal basis viewing the associated costs of constructing, maintaining and operating a single permanent common classroom addition and a single relocatable classroom. The purpose of this analysis is to provide information on the relative lifetime costs associated with the employment of each type of structure for use in policy decisions concerning the growing use of relocatable classrooms in this state. Primary emphasis has been placed on determining the purchase price and annual lease rate of relocatables (on a square foot basis) which produce a discounted life cycle cost stream equivalent to that of a conventionally constructed permanent classroom addition. The resulting square foot costs represent a price ceiling that can be used as a guide in evaluating the construction verses

lease/purchase decisions. It should be noted that all analysis has been carried out under the assumption of a structure size of 1,000 square feet.

In performing this analysis calculations were carried out for two broad divisions covering low-end as well as mid- and upper-end unit costs. Each of these two broad divisions was further broken down into two sub categories. One in which it has been assumed that the annual operating and maintenance cost parameters for a relocatable are equal to those of a permanent classroom and another in which these parameters are set to the levels given in the methodology section. The analysis of each division was carried out over a range of capital costs (6.00%, 6.50%, 7.00%) and inflation rates (3.25%, 3.75%, 4.25%). The baseline parameter values are 6.50% for the cost of capital and 3.75% for the annual rate of inflation.

The baseline results indicate that the break-even per square foot price for a low-end relocatable with annual operating and maintenance costs equivalent to a permanent classroom addition is approximately $31 while that of a relocatable with annual operating costs of $1,200 and maintenance costs of $2,750 is $19. For the mid- to upper-end category, the break-even price of a unit with operating and maintenance costs equal to those of a permanent classroom addition was calculated to be $37 and that of a unit with annual operating costs of $1,100 and maintenance costs of $2,500 at $29.

As evident, the break-even prices for higher-end relocatables are higher than those for the lower end units. This is due to the fact that these units are constructed with superior quality materials which would extend their service life five years beyond that of low-end units (35 years as compared to 30 years) and should confer operating and maintenance cost efficiencies over lower priced units.

In order to gain insight into annual relocatable lease rates that produce life cycle costs equivalent to those of a permanent classroom addition, calculations were run over a range of annual operating costs of $10, $11 and $12 per square foot. Maintenance costs are not an issue as most lease contracts are arranged such that the leasing company carries the annual maintenance costs on their stock. From our calculations, the baseline break-even lease rates are $4.35 for a unit with annual operating costs of $1,000, $4.25 for unit with annual operating costs of $1,100 and $4.15 for a unit with annual operating costs of $1,200.

In order to better understand the implications of a cited break-even price or lease rate for a given relocatable, a graphical description has been given below. What this information shows is that for all purchase prices or lease rates lower than the break-even rate the use of relocatables provides the same set of services at a lower overall life cycle cost than a permanent addition would. On the other hand, at prices above the break-even level relocatables are the less cost efficient (more expensive) and thus a lower quality investment as compared to a permanent addition. This graph also highlights how crucial the operating and maintenance costs are to the overall investment quality of relocatables as indicated by the lower break-even price for a relocatable with annual costs greater than those of a permanent addition.

Tables covering the full range of results for each of the various analyses performed are contained in Appendix E. The tables display the calculated net present value of the life cycle costs and breakeven prices conditioned on the particular assumptions made concerning the various cost parameters employed.

Teacher Survey Response Analysis

Question 1, "Grade Level Taught By Respondent." Responses to this question appear to indicate that the primary use of relocatable classrooms occurs in the elementary grades (Pre-kindergarten through 6th grade) as 61.8% of the respondents came from this group, while 32.7% came from those teaching in grades seven through twelve (assuming that the sample is representative of the true population). The single highest representation came from those teaching fourth, fifth and sixth grades (27.2%) and the lowest representation came from those teaching seventh, eighth and ninth grades. Special education instructors composed 9.6% of the sample.

Question 2, Years of Experience. Responses to this question display a relatively stable distribution of respondents according to years of teaching experience. The highest proportion of respondents (23.8%), indicated that they had 21 or more years of teaching experience.

Question 3, Years Experience in Relocatable. The distribution of responses to this question shows a distinctly larger number of respondents (64.2%) who have three or more years of teaching experience in a relocatable environment. The highest representation came from those with three to five years experience.

Question 4, Type of Relocatable Currently Teaching In. The overwhelming majority of respondents (84.4%) indicated that they currently teach in what is termed a "Standard" size relocatable. A very low proportion of respondents (4.2%) indicated that they were currently teaching in a "narrow" unit, and 11.4% indicated they are housed in a "long" unit.

Question 5, Age of Relocatable. Based on the responses to this question, over 50% of the respondents currently teach in relocatables that have been in use for five or more years, with the highest proportion (39.4%) indicating the age of their unit as between

five and fifteen years. Eighteen percent of the sample indicated that they were currently in units over fifteen years.

Question 6, Maximum Number of Students. According to the respondents, the most common classroom capacity in currently-employed relocatables is in the range of 21 to 30 although there was a high proportion (32.7%) reporting classroom capacities exceeding 30 students. Observation of cross-tabulations run on class size by grade level shows that those reporting class sizes greater than 20 but less than 31 predominantly come from those teaching in the elementary grade levels, while those reporting class sizes greater than 30 students generally are associated with grade levels 7 through 12. As would be expected, class sizes for Special Education and Pre-kindergarten/Kindergarten purposes ran much lower than the other categories with the majority of this grouping citing class sizes of between 11 to 20 students.

The overall purpose of analyzing the response data for the following questions is to try and discern any detectable problem areas that may exist, or exist to a greater degree with the use of relocatable classrooms as compared to permanent classroom structures. Since it is not only important to discover any aggregate problem areas but also to determine how problems may be more or less sensitive over the ranges of the characteristics described in questions one through six, the results from numerous cross-tabulations have also been studied and reported.

In order to provide information on the aggregate response conditions over the entire sample, standard Z-Score tests have been performed on the mean response value for each of the given questions. As the data was input with a numeric value of one through four according to the ordinal position of the response, with a value of one being placed on a "Strongly Agree", a two being placed on a "Moderately Agree" response, a

questions.

The hypothesis testing procedure consisted of testing whether a sample mean lies significantly above or below the level of 2.5, with the computed Z-Score determining the magnitude of difference. Resulting Z-Scores either rejected or did not reject the hypothesis based on its lying or within or without the critical value of 1.645 deviations. All tests were carried out at this level of significance (a=0.05).

Question 7, The design of the relocatable allows me to arrange my classroom in ways that encourage optimum learning. Responses to this question suggest that, in general, relocatables do not have any inherent disadvantage with respect to allowing the classroom arrangements considered by the respondents to be conducive to promoting optimum learning. Based on the frequency distribution of the response, 62.3% of the respondents either strongly or moderately agreed with the given statement. The degree of commitment was not overwhelming, as the single largest proportion of responses (41.6%) fell in the "moderately agree" response category. The hypothesis that there is an inherent problem in relocatables with respect to providing classroom arrangements conducive to optimum learning was addressed by testing to see whether the sample mean was greater than 2.5 (i.e. respondents generally tended to disagree with the given statement). The computed Z-Score of -3.6 resulted in the rejection of this hypothesis, which means that over the entire sample there was not a significantly high enough number of disagreeing responses to suggest that the average respondent disagreed with the statement.

In order to check whether there may be existing problems in a particular grade level, cross-tabulations were run comparing responses to question seven by grade level taught. While there was no case in which a higher proportion of responses by grade level

came out in disagreement with this statement, there was some evident discontent in the elementary and middle grade levels. Across these grade levels approximately 25% of the respondents "strongly disagreed" with this statement.

There appears to be a strong level of dissatisfaction among those respondents teaching in "narrow" relocatables, as 51.6% of this group "strongly" disagreed with this statement. Among those in relocatables over fifteen years old 35.8% of the respondents group gave a "strongly disagree" response. These results suggest that both smaller sized and older relocatables may tend to be problems in this area.

Question 8, Physical layout of the relocatables and the possibility to use new technologies. Fifty five percent of all the teachers responded favorably to this issue. This means that certain types of relocatables are flexible enough to accommodate current computer laboratories and audio-visual settings. The flexibility of the relocatable classroom is attributed to the relationship between the length and width of the classroom. The better the proportions , the more accommodating the classroom will be.

Question 9, Adequate storage areas. Of the teachers surveyed, 61% indicated that storage was a problem. This is a concern that should be directly addressed in the design specifications so that the manufacturers can allow for more storage space during the conceptual stages of the building process. Storage space can be added in numerous ways. Manufacturers have several options to satisfy this deficiency. The most obvious one is to add more spacious cabinetry along the side of the classroom, or simply by allowing for more shelving space.

Question 10, Adequate ceiling height. An overwhelming 88% responded favorably. It does not seem, from the teachers' response, that low ceilings is a negative aspect for regular classroom activities. In fact, the ceiling is utilized to hang student work. The setback, however; is that there is an important loss in light levels due to obstruction of ceiling light fixtures.

Question 11, Adequate lighting. According to the respondents, there was no major problems associated with task light. Eighty one percent indicated that the task light provided was sufficient.

Question 12 "Overall lighting conditions lead to a pleasant learning environment." There is a very high level of satisfaction with the lighting supplied in relocatables. A full 43.5% of respondents indicated that they strongly agree with the above statement and only 18.8% gave either a "moderately" or "strongly" disagree response. As a whole, 78.6% of the respondents agreed that lighting conditions in relocatables provided a pleasant learning environment. The hypothesis test for a sample mean greater than 2.5 (indicating dissatisfaction) was easily rejected as the computed Z-Score was -21.1.

Response evidence from those teaching Special Education and fourth, fifth or sixth grade classes noted the highest levels of dissatisfaction with the lighting conditions in their relocatables. Perceived problems by Special Education teachers may be due in large part to the fact that as a whole Special Education classes are held in disproportionate numbers in older relocatables. Viewing the responses to question 12 over the age classes of relocatables it is apparent that greater levels of dissatisfaction are associated with older units.

Question 13, Effect of limited windows on learning. Fifty six percent of all the respondents indicated that the absence of windows did not have an adverse effect on the

learning environment.

Question 14 and 15, Adequate air movement, and fresh air. Seventy three percent of the teachers did not consider lack of air movement to be a problem. Sixty seven percent indicated that adequate supply of fresh air is available. These responses indicate that most relocatables are well ventilated.

Question 16, Comfortable air temperature. Seventy three percent agreed that generally the temperature of a relocatable is comfortable. Since relocatables have independent units, the temperature control of each unit is greatly facilitated.

Question 17, Noise created by the air conditioning/heating system does not interfere with effective communication and learning. The number of negative responses concerning the level of HVAC noise indicates that the majority of teachers in relocatables feel that these units produce a noisy environment that is not conducive to adequate communication and learning. Across the entire sample 51.9% of the respondents disagreed with the above statement. A z-score of 3.5 was large enough to fail to reject the hypothesis that the true mean was greater than 2.5 at a 0.05 level of significance. This result indicates that a problem exists with respect to the level of noise emanating from the package terminal air units in existing relocatables.

The frequency of respondents choosing "strongly disagree" held the highest proportion of responses in the sample. Those respondents teaching grades one through six were approximately 1.5 times as likely to give a "strongly disagree" response as the remainder of the sample. The fact that there seems to be a greater problem associated with HVAC noise levels in relocatables housing younger students may stem from the ease with which these young minds can be distracted. The problem is real nonetheless.

Noise level does not appear to be as much of a problem in larger relocatables.

In fact, respondents teaching in "long" units had a much higher proportion of agreement (57.6%) rather than disagreement (38.7%) with the given statement. The age of the unit also seems to be a relevant factor affecting the perception of HVAC noise levels.

Of those respondents in units employed 15 or more years 63.5% reported that noise levels in their units interfere with communication and learning. By contrast, only 38.4% of those in units less than four years old indicated that they perceived a problem. Changes in building design, HVAC unit location, advances in building materials and HVAC technologies, along with a host of other factors, could be responsible for the lessened perception of noise problems in newer relocatables.

Question 18, Problems with outside noise. Of those who had problems with outside noise, the majority commented that their relocatables where either too close to a highway, playing ground, or other school activities that generated noise. Careful attention needs to be paid when installing relocatables on the school grounds. The facility planner must consider noise as an issue when allotting space for relocatables. Burms, trees and shrubs should be utilized whenever possible to buffer and reduce unwanted noise.

Question 19, Adequacy of the acoustics. Concerning the acoustical qualities of the relocatable classroom, 71 % of the respondents did not indicate noticing any problem. Twenty five percent of the respondents indicated that the quality of their classroom acoustic was poor. These responses presume that the teachers' comments are based on their abilities to communicate intelligibly with the students.

Question 20 and 21, Plumbing facilities are adequate and odor problems. Twenty six percent of the respondents strongly disagree with the adequacy of the plumbing facilities. It must also be reported that 22% of these facilities have problems with undesirable odors.

Question 22, Adequate electrical outlets. A surprising 32% of the respondents indicated a lack of electrical outlets for use of equipment needed for teaching. This is an issue that can be easily corrected in the design specifications.

Question 23, I must be more concerned with safety issues in my relocatable than in a permanent classroom. The frequency of responses to the concern for safety is approximately uniformly distributed with the same number of respondents in agreement as disagreement. Respondents teaching Pre-K/Kindergarten and high school students had the lowest levels of perceived concern about differences in safety between relocatable versus permanent classrooms, although approximately 40% of those teaching in these grade levels did agree that they need be more concerned with safety issues when in a relocatable environment.

The level of concern for safety was notably higher among respondents teaching in "narrow" units (67.7%) as compared to those in larger units (432%). One possible source of this variance could be that these units are most commonly used for Special Education classes which in and of themselves demand more attention to safety concerns than do other categories. In this case, unit age appears to be a factor causing concern for safety issues as the proportion of respondents agreeing that they need be more concerned with safety issues rises with the age of the relocatable. The proportion in agreement rises from 35.7% in units 1-3 years old to 59.6% in units 15 years or older.

Question 24, Vandalism problems, permanent vs. relocatables. 76% of the respondents indicated some concern with vandalism. Fifty six percent indicated great concern of vandalism with relocatable classrooms as compared to permanent classrooms. Vandalism is related to several issues: the most important issue being the arrangement of relocatables and their relationship to the site. Planners must avoid creating blind

spaces and dark corners between structures. A skirt/screen should be installed around the base of the unit to prevent persons from hiding in the crawl space below. There should be enough light between relocatables to deter persons from hiding.

Question 25, I feel just as secure in my relocatable as I do in a permanent classroom. With respect to a perceived feeling of security, the majority of respondents (57.2%) indicated that they felt just as secure in a relocatable as in a permanent classroom. The Z-test statistic for the sample mean failed to support the hypothesis that the mean was greater than 2.5 leading to its rejection. In general, respondents from lower grade levels had a higher propensity to disagree with the above statement, and teachers of Pre-kindergarten and Kindergarten students felt the least secure being in a relocatable.

A lower perception of security was also evident among less experienced teachers. The frequency of responses in disagreement fell from 47.4% for teachers with zero to five years experience to 35.1% for teachers with 21 or more years experience. Perhaps for those with less experience, a lessened sense of security comes along with being separated from peer support. Respondents occupying "narrow" relocatables had a very high rate of disagreement (41.9%) with this statement, which is roughly twice that from the other two types. With respect to unit age, the largest proportion of "strongly agree" responses came from respondents in units from 1-3 years old while the highest proportion of "strongly disagree" responses came from those in units greater than 15 years old.

Question 26, During inclement weather I feel secure in my relocatable. In viewing the responses to this question it is quickly apparent that most respondents do not feel particularly secure in their relocatable during times of inclement weather. Over the entire sample a full 62.5% of the respondents signaled that they did not feel secure in a

relocatable during adverse weather conditions.

Testing of the hypothesis that the sample mean was greater than 2.5, or that on average respondents disagreed with the statement, produced a failure to reject as the resulting z-score of 10.6 was well above the 1.645 critical value. As would be expected there was a significantly lower sense of security as the grade levels got lower. The proportion of respondents giving a "strongly disagree" response fell from 51.1% for Pre-K/Kindergarten to 16.5% for educators teaching in high school grade levels. Years of teaching experience and time in a relocatable environment had no effect on the distribution of results in this case. The type and age of the unit occupied had a very marked effect on the response distribution across unit type. The proportion of respondents indicating that they strongly disagreed fell from 64.5% for those in a "narrow" unit to 28.2% for those in a "long" unit and rose from 16.1% for those in units 1-3 years old to 48.9% for those in units older than fifteen years

Question 27, Uncomfortable setting for teaching due to physical condition of the relocatable. The majority of the respondents indicated that the physical condition of the relocatable classroom did not create an uncomfortable setting for teaching activities.

Question 28, Aesthetics and teachers' attitude towards teaching. Of the respondents, only 20% felt that the aesthetic qualities of the classroom environment affected their attitude towards teaching.

Question 29, The building materials used create a comfortable environment for learning. Seventy percent of the respondents agreed that the materiality of the classroom provided a suitable environment for learning.

Question 30, Teaching in a relocatable classroom creates feelings of inequality with other teachers that have a permanent classroom. Responses to this question firmly

indicate that teachers have few problems of feeling inadequate in comparison to peers who have permanent classrooms. Of those respondents who gave a response within the agree/disagree range, 75.4% indicated that they disagreed with the above statement. A full 60% signaled that they "strongly disagreed" that they have any feelings of inadequacy associated with teaching in a relocatable.

The only group that exhibited any significant signs of strong agreement were those teaching in "narrow" relocatables. Roughly one-quarter of those in this group indicated that they greed with feelings of inadequacy.

Question 31, Teaching in a relocatable creates a negative feeling of isolation from the other teachers in the school. As was the case with question 30, the response data for this question indicates that, in aggregate, most teachers (60.0%) in relocatables do not have any problem with feelings of isolation from their peers located in permanent facilities. The highest overall response frequency was in the "Strongly Disagree" category which was chosen by 40.7% of the respondents. Although small in comparison, it should be noted that approximately 15% of the respondents strongly agreed with the statement of a negative feeling of isolation.

The propensity for strongly agreeing with the statement was higher for those in smaller and older units but was not effected by any of the other descriptive characteristics.

Question 32, Teaching in a relocatables hinders my relationship with others. Fifty six percent of the respondents did not think that teaching in a relocatable would hinder their relationship with other instructors. In fact, the reason they especially enjoy teaching in relocatables is mainly attributed to the feeling of independence. They particularly enjoy the self contained, detached teaching environment.

Question 33, Walkways leading to my relocatable are adequately covered. Evidence from the responses to this question suggests that there is a perceived problem with inadequately covered walkways leading to relocatables. Approximately 70% of those sampled indicated that they felt there are inadequate walkway coverings, with 62% strongly disagreeing that coverings are adequate.

This level of dissatisfaction was uniformly strong across all grade levels, unit ages and types, and levels of experience. All things considered, there appears to be a need for a more expansive walkway covering system associated with the use of relocatable classrooms. One reason for a possible lack of adequate walkway coverings leading to relocatables could be related to the primary use of relocatables which is to fill-in gaps in intra-district enrollment patterns. Due to the frequent moves of relocatables from site to site, it should not be surprising that there is little investment in walkway coverings.

Question 34, The location of relocatables in relation to other facilities in the school created problems. Fifty four percent of the teachers that answered this question disagreed with the statement. They did not observe any problem with their relocatable in relation to the rest of the school's facilities.

Question 35 and 36, Teaching and curriculum changes due to the introduction of the relocatables. The introduction of relocatables does not seem to have affected, neither the teaching style nor the curriculum of most teachers.

Question 37, I encounter less discipline management problems in my relocatable than in a permanent classroom. The frequency of responses indicating disagreement with this statement (48.5%) was approximately twice as large as that of those in agreement. For some reason, 25.5% of the respondents chose a "Not Applicable" response in this case. There was only one other case for which there was a sample percentage of

response in this category above 6.0% and it only ran at 15.0%.

This result may be related to an aversion by teachers to admit that discipline management problems even exist. If we assume that the distribution of responses in this group would have been approximately equivalent those of the small sample who actually made an agree/disagree response, then there does seem to be a perceived problem with discipline management in relocatables as compared to permanent classrooms. It should be noted that disagreement with this statement could also indicate that discipline management problems are equivalent between relocatables and permanent classrooms.

Looking at cross-tabulations across grade levels it appears that the overall level of disagreement is strongest in the lower grade levels and declines substantially among high school educators, although one-third of those teaching in the high school grade levels indicated that a problem exists. Evidence across the number of years teaching in relocatables suggests that this is not purely a problem of teachers getting used to handling students in this environment as the proportion in disagreement remains equally strong across the stratum. Again, smaller sized units seem to exacerbate the problem as the range of strong disagreement falls from 41.9% for those in "Narrow" units to 18.8% for those in "Long" units. The age of the relocatable has no significant effect on the frequency of a strongly disagreeing response.

Question 38 and 39, Students prefer relocatables and parents do not object to their children being taught in relocatables. Thirty percent of the teachers indicated that their students preferred relocatables. The majority or 36% responded "Not Applicable" which supposes that this question was never raised before. Over 50% of the respondents affirmed that parent did not object to their children being taught in relocatable classrooms.

Question 40, Accessible to and usable by persons with disabilities. Forty four

percent of the respondents indicated that their relocatable classroom was not accessible to or usable by persons with disabilities.

CHAPTER 5:

Summary

An attempt was made throughout this study to find answers to the questions posed in the Request for Application (RFA) regarding the use of relocatables, relying on the information gathered from 85% of the facilities planners throughout the state, as well as over 900 teachers who work in the relocatable classroom. Schools throughout the state were visited to better understand their actual conditions and utilization, and a literature review of over 203 listings was conducted. Builders and industry representatives were consulted on the aspects that relate to relocatable construction and design, and manufacturing plants that build the relocatable were visited.

Discovered during the course of this research was the multifarious aspects of the relocatable classroom and its use in the public school districts of Florida. This building type has a variety of plan configurations, styles and features. It varies considerably in age (new to forty plus years) and manifests a variety of observable conditions/characteristics resulting from materials used in construction and level of maintenance. Furthermore, relocatable classrooms are used from special education courses and pre-kindergarten to high school and college. This diversity of use also complicates defining the general use of the relocatable classroom. These variations also make it difficult to establish general comparisons between the site-built (permanent) classroom and the relocatable classroom. Further complicating this matter of comparisons is the variety of permanent schools themselves. In addition to this facilities diversity there are differences between each of the public school districts. Not only are the sizes and fiscal health of the districts different but each district has its own policies pertaining to the use of relocatables. For reasons

just described, it has been a complex task to evaluate the use of the relocatable classroom and its relation to the traditional site-built classroom.

Equally challenging is how to determine a measure to ascertain how relocatables affect the learning of students. Information obtained from the literature search on the classroom environment, the teachers surveys and school site visits provided the means for understanding the effects of the relocatable environment on a students well-being, achievement and behavior. By understanding the aspects that create an ideal setting for learning and the components that make for an effective classroom environment a framework was established for evaluating the learning environment of the relocatable classroom. The relocatable classroom was then analyzed according to the following environmental variables: physical space, light, acoustical environment, thermal environment, air quality, and aesthetics. Teachers throughout the state submitted questionnaires regarding their feelings toward the physical classroom environment. Finally, by visiting selected schools throughout the state it was possible to survey first-hand the actual status of the relcoatable classroom environment. Not a part of this research was an empirical study of student achievement based on testing procedures and scores, or behavioral observations.

During the course of this research on the financial implications of the employment of relocatable classroom, primary focus has been placed on answering questions concerning the comparative costs of portables posed in the RFA. While it was possible to accurately determine some elements of the specific costs associated with this type of structure there are a couple of areas for which the information collected does not provide a clear cut picture.

Information collected from the survey instrument, personal interviews with various facility planners and earlier studies performed by other state school district organizations was adequate for the purposes of estimating the moving costs involved in the relocation of a portable classroom as well as the periodic refurbishment and replacement costs normally encountered over the lifetime of a portable. The estimated costs for each of these categories based on the available information was presented in the cost parameter segments of the methodology section.

Unfortunately, there was no consensus on the annual operating and maintenance costs for portable classrooms as compared to those for a permanent classroom structure. Although information contained in a report performed by the Flagler County School District did provide estimates of these costs which depicted them as being nominally higher in comparison to permanent facilities, the resulting information from both the survey instrument and personal interviews conducted during the course of this research showed that almost half of the respondents felt that there was no difference in cost between the two types of structures. The main reason for the inability to accurately determine these figures lies in the fact that most often individual districts do not track this information on a disaggregated basis. It should be noted that the level of annual operating and maintenance costs does have a substantial impact on the net present value of the life cycle cost stream but can not be any more accurately determined without further research.

For reasons earlier described, a direct financial comparison of permanent and portable classrooms inclusive of moving costs is not feasible. Although both types of structures provide the same basic service, the provision of space with which to carry on the education of Florida students, portable classrooms have the ability to be relocated in short order to other locations. This mobility should be viewed as an asset. However, if

moving costs were to be included they would in effect suggest that the ability of portable classrooms to be relocated is a liability rather than an asset.

In order to compare the two types of structures on a like basis it must be assumed that the portable will not be relocated and thus there will be no moving costs carried. With this point made, it can be stated that accounting for their life expectancy, required maintenance and operating efficiencies, portable classrooms can be just as "good" an investment as permanent classrooms within a specific unit price or annual lease rate range. Estimates of per square foot prices and lease rates for which portables would be an equally "good" investment as compared to the construction of a permanent classroom addition were given in the financial results section.

CONCLUSIONS

1. Where are relocatables being used?

Every public school district in the state uses relocatable classrooms. Some districts have as low as 4 units and others as high as 2,300. (See Figure 2B) Though it appears that some districts may use a larger number of relocatables than other districts the actual percentage of use of relocatables in a district (number of units in relation to the total number of students in that district) may be small proportionally. (See Figure 2A). The total number of relocatable facilities for educational purposes now being used in the state based on the facilities questionnaire and current FDOE data is over 16,000.

By far the largest user of relocatable facilities is the Elementary School (51%),* followed by Senior High then Middle School. Together these three school types make up 80%* of all relocatables being used. The remaining school types comprise the other 20%. (See Figure 5)

When facilities planners were asked what the primary consideration is for where a specific relocatable classroom should be placed on a site in relation to permanent buildings, the majority of responses listed proximity and availability of utilities. Does site terrain become an issue in the relocation of the relocatable? A large majority of those responding to the facilities questionnaire said yes.

2. How often are these portable classrooms relocated and why?

Over a one year period (1992) 10% of the existing relocatables throughout the state were moved (this did not include first moves for new relocatables). Some districts reported that they have never moved any of their relocatables. Twenty five of the smaller districts with less than 100 relocatables reported moving, per district, 5 or less relocatables in the last 5 years. In the last 5 years approximately 7,000 relocatables were moved within the combined public school districts (number of moves over the last 10 years was not determined because of insufficient data).

The primary reason districts choose to move relocatable classrooms is because of population shifts and increases in student enrollments. Other reasons include new programs, new construction and renovation. The primary reason districts choose to purchase, construct, or lease relocatable classrooms is because of immediate housing needs. Enrollment shifts (mobile student population) and economy (lower cost than

permanent construction) are the next major reasons districts obtain relocatables. Other reasons for using relocatables include new programs, new construction and renovation of existing facilities. (See Figure 3)

3. *How long do relocatable classrooms remain in use?*

Information from the surveys sent to district level school officials indicate that respondents expected a service life of 23 years for a relocatable. Some respondents reported having relocatables that have been in use for more than 40 years. Newer designs incorporating construction that is more permanent, and when properly maintained, could expect a life span beyond 40 years.

4. *How do they compare to the longevity and use of permanent space?*

It is important here to clarify some terms. Permanent space refers to facilities that are fixed-in-place and generally built on the site. Portable space refers to facilities that are designed to be moved from one location to another and are generally built off-site in a manufacturing plant. The differences between the two types have to do with construction methodology not construction materiality. Longevity should be equal assuming that both facilities are built using the same construction systems and that the relocatable is not moved once it is located on the school site (the fact that the relocatable is moved adds additional strains to the system and increases its chances for damage and deterioration, a stress not imposed on permanent space - even though the portable space is designed for moving). In addition, many of the relocatable facilities employ construction systems of light wood framing with plywood facings, a building system not allowed by the

state building code for permanent space facilities. The longevity aspects are obvious when comparing a wood frame facility with plywood facings to a facility with concrete block and brick veneer. Though light frame construction and plywood facings can have an acceptable life expectancy the cost and time to maintain this structure is quite different from masonry and brick. If the relocatable facilities are not maintained properly then the life-expectancy changes considerably. Sometimes the lack of proper maintenance of relocatables is a result of districts viewing them as temporary facilities and not giving them the same attention as permanent space. The manufacturing industry is capable of producing portable space with the same qualities found in permanent space. However, the additional expenditures required would lessen the attractiveness to some districts who are making their decisions to purchase relocatables based simply on cost.

When district planners were asked if the use of portable space in their districts differs from the use of permanent space an overwhelming majority of those responding said no. Some districts use relocatables only for smaller classes. Others only use the spaces for special programs. When asked if the intended use of the relocatable classrooms in their districts changed due to the condition of the unit over time, 48 percent said yes, 50 per cent said no, and 2 percent said sometimes.

5. How are the "core" spaces of a school affected by the use of relocatable classrooms?

The "core" spaces of a new school (library/media center, auditorium, cafeteria, administrative areas, etc.) are designed to handle "ultimate" capacities while the classrooms are built for only "initial" capacities. When classroom space is added to an existing facility, whether it is for a new permanent addition or relocatables, and does not

create population increases over the ultimate capacity, the core spaces should not be adversely affected. However, many times relocatables are employed at a school after the ultimate capacities have been reached, adversely affecting the school "core". This increase in the number of students, teachers and staff as a consequence of relocatables results in the overcrowding of these areas.

Cafeterias must reschedule lunch over a longer time period, increasing staff time and requiring some students to eat either too early or too late. This puts additional strains on equipment, floors, hardware, and lunchroom supplies. It increases energy consumption for these areas and requires additional maintenance and cleaning.

The auditorium experiences similar strains as well as needing to schedule more times for auditorium use and the inability for the entire student body to assemble.

One facility planner discussed the effects of these population increases on the library media center. When the number of students increased as a result of the increased use of relocatables an accrediting group required that the library have more books. However, the library was already filled to capacity. To receive accreditation the library had to be expanded. In addition to this problem libraries, media centers, music and art rooms all have more wear and tear on carpet, HVAC in addition to the other affects listed previously.

Administration and faculty staff areas also experience similar adverse effects and a decreased level of comfort with less room for administration and support.

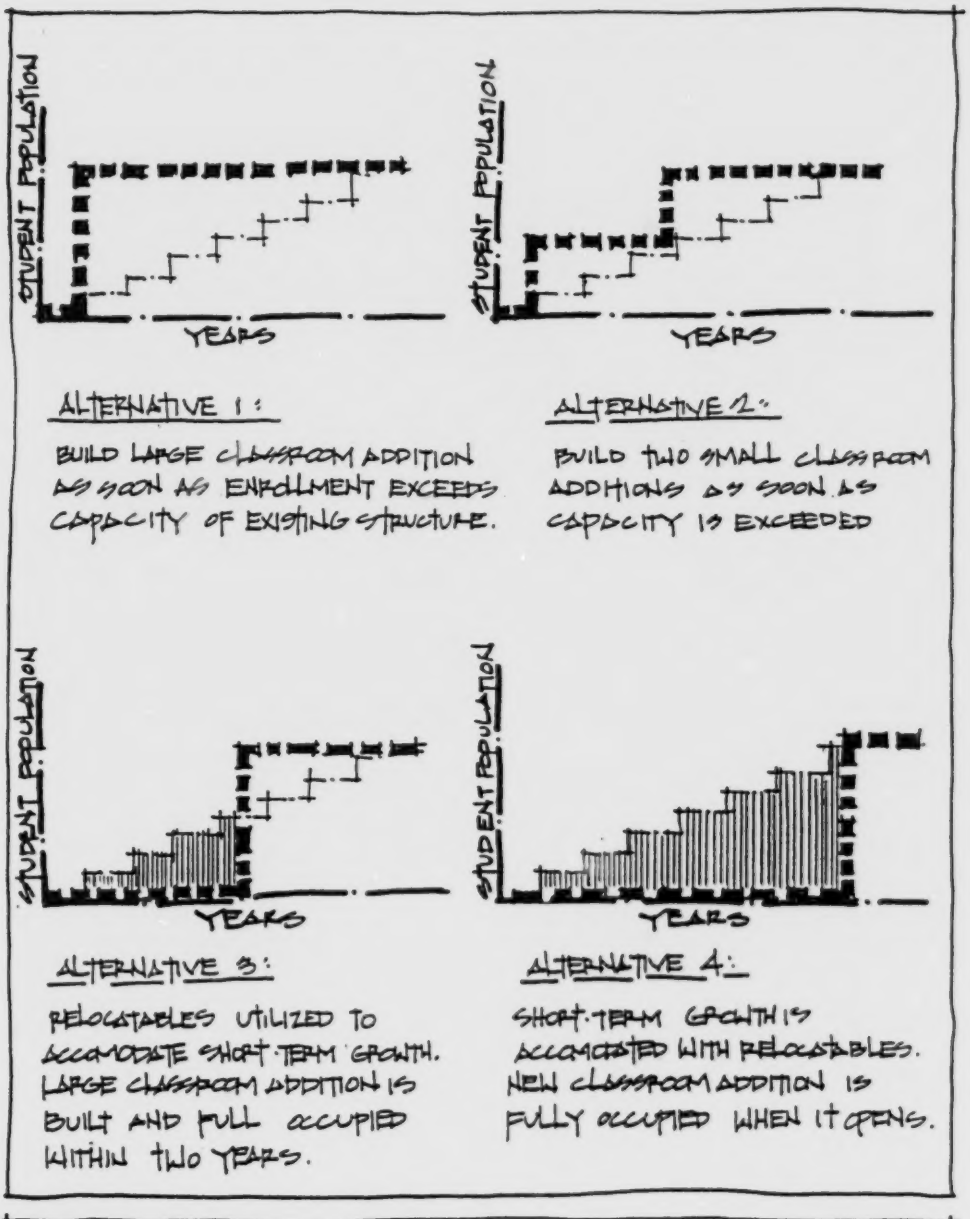
The playground areas are also impacted by relocatables. Many districts reported a loss of playground area due to the placement of relocatables. Scheduling problems and decreases in playground activities occur as a result. On rainy days multipurpose areas are altered. Playgrounds have more wear requiring reseeding. Restoration of a

playground is required once the relocatables are gone. Playground overcrowding creating unsafe conditions was listed as one adverse effect by a district.

Parking areas are also impacted. Cars sometimes need to park on the grass. Some faculty no longer have a place to park. More buses and cars creates unsafe conditions and delays as well as increased wear of roadway areas. (See Figures 13, 14, 15, 16 and 17)

6. During severe weather situations such as tornadoes, hurricanes, hail, and heavy rain fall, what is the type of severity of damage that occurs to relocatable classrooms as compared to permanent construction?

An overwhelming majority of those responding to the facilities questionnaire stated that the relocatable endured severe weather conditions satisfactorily, with many responding very well (however, one district listed a tornado removing a roof). Following the aftermath of hurricane Andrew, Dade County reported only two relocatables that were totally destroyed. When asked how the severity of damage compared to permanent site built structures, again the majority of those answering the question either responded that they were the same or experienced less damage than permanent structures. The major type of damage incurred by relocatables from high winds and heavy rain was roof damage. In a report of the effects of hurricane Andrew (see Chapter 2) on the Dade County Public Schools it states: "Portables were destroyed due to the failure and/or lack of anchorage. One portable was observed to have lost its stud connection to its floor. Portables were observed to have been shifted on their foundations. Portables were also highly susceptible to the other types of observed damage: roof loss, breaking of glass windows, and impact damage from airborne debris. As most masonry construction could


STUDENT POPULATION
YEARS
ALTERNATIVE 1:
BUILD LARGE CLASSROOM ADDITION AS SOON AS ENROLLMENT EXCEEDS CAPACITY OF EXISTING STRUCTURE.
STUDENT POPULATION
YEARS
ALTERNATIVE 2:
BUILD TWO SMALL CLASSROOM ADDITIONS AS SOON AS CAPACITY IS EXCEEDED
STUDENT POPULATION
YEARS
ALTERNATIVE 3:
RELOCATABLES UTILIZED TO ACCOMODATE SHORT-TERM GROWTH. LARGE CLASSROOM ADDITION IS BUILT AND FULL OCCUPIED WITHIN TWO YEARS.
STUDENT POPULATION
YEARS
ALTERNATIVE 4:
SHORT-TERM GROWTH IS ACCOMODATED WITH RELOCATABLES. NEW CLASSROOM ADDITION IS FULLY OCCUPIED WHEN IT OPENS.

SCHOOL EXPANSION ALTERNATIVES

SOURCE: ADAPTED FROM THE METROPOLITAN SCHOOL BOARD FOR STUDY OF EDUCATIONAL FACILITIES, P. 27.

Figure 13

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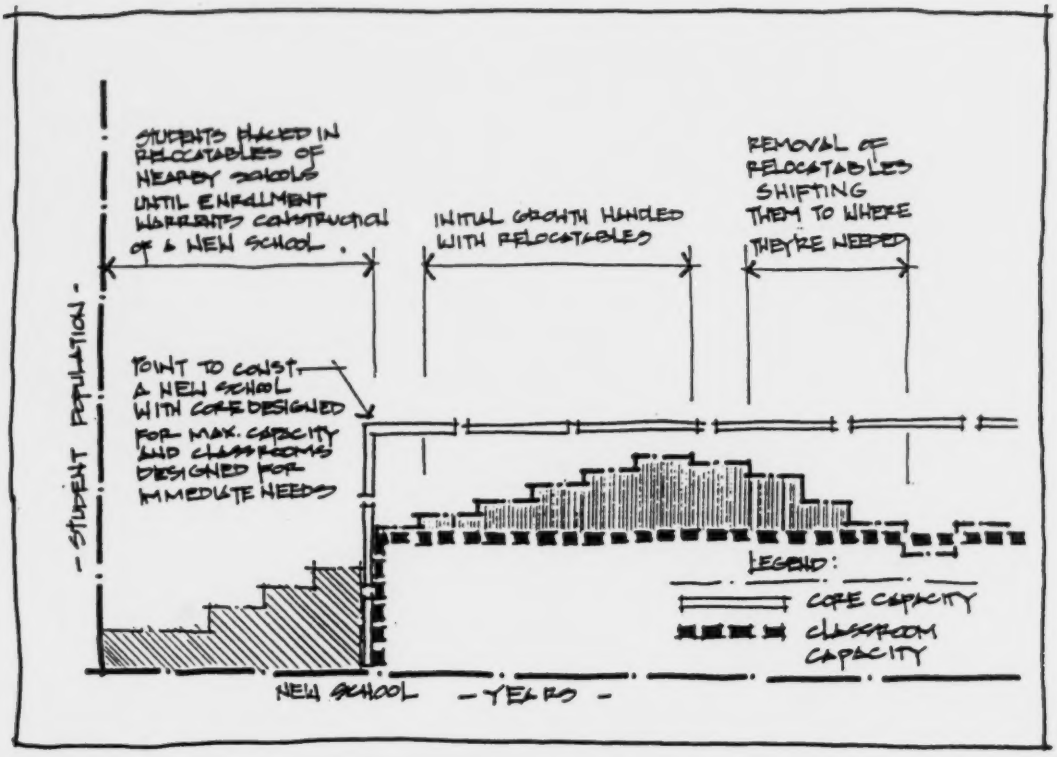
STUDENTS HACKED IN RELOCATABLES OF NEARBY SCHOOLS UNTIL ENROLLMENT WARRANTS CONSTRUCTION OF A NEW SCHOOL.
INITIAL GROWTH HANDLED WITH RELOCATABLES
REMOVAL OF RELOCATABLES SHIFTING THEM TO WHERE THEY'RE NEEDED
POINT TO CONST. A NEW SCHOOL WITH CORE DESIGNED FOR MAX. CAPACITY AND CLASSROOMS DESIGNED FOR IMMEDIATE NEEDS
- STUDENT POPULATION -
LEGEND:
CORE CAPACITY
CLASSROOM CAPACITY
NEW SCHOOL
- YEARS -

BUILDING GROWTH

PEAK WITH DECLINE

SOURCE: ADAPTED FROM THE METROPOLITAN SCHOOL BOARD FOR STUDY OF EDUCATIONAL FACILITIES, P. 25.

Figure 14

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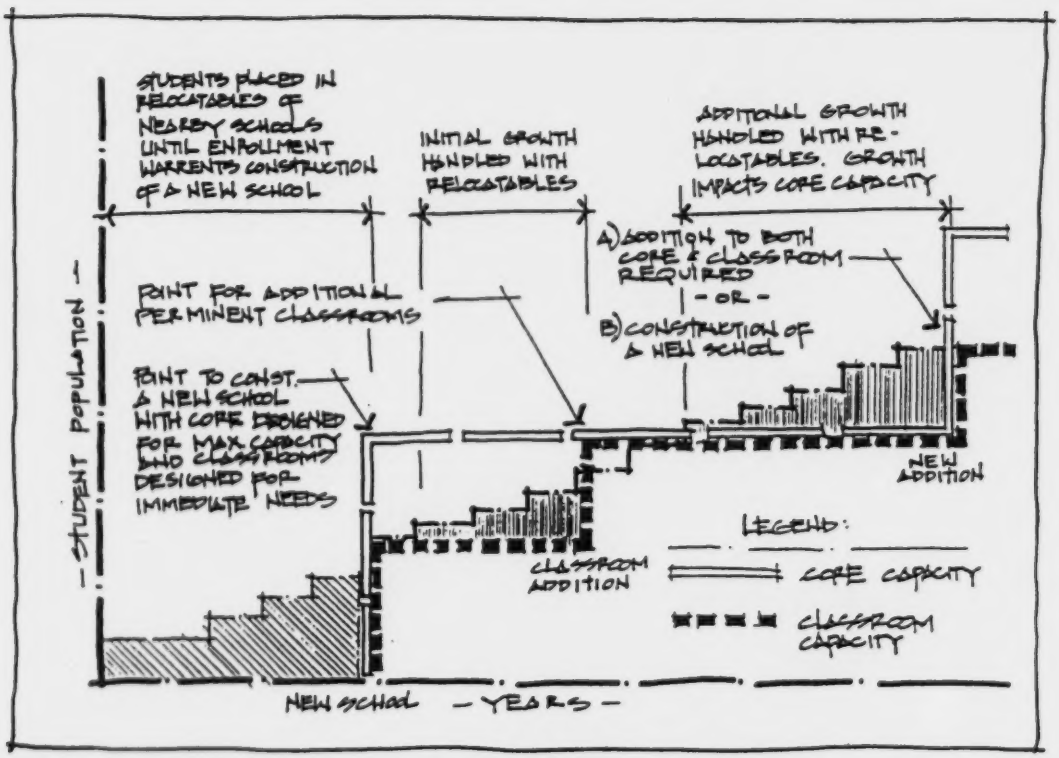
STUDENTS PLACED IN RELOCATABLES OF NEARBY SCHOOLS UNTIL ENROLLMENT WARRENTS CONSTRUCTION OF A NEW SCHOOL
INITIAL GROWTH HANDLED WITH RELOCATABLES
ADDITIONAL GROWTH HANDLED WITH RE-LOCATABLES. GROWTH IMPACTS CORE CAPACITY
A) ADDITION TO BOTH CORE & CLASSROOM REQUIRED
- OR -
B) CONSTRUCTION OF A NEW SCHOOL
POINT FOR ADDITIONAL PERMINENT CLASSROOMS
POINT TO CONST. A NEW SCHOOL WITH CORE DESIGNED FOR MAX. CAPACITY AND CLASSROOMS DESIGNED FOR IMMEDIATE NEEDS
- STUDENT POPULATION -
NEW ADDITION
CLASSROOM ADDITION
LEGEND:
CORE CAPACITY
CLASSROOM CAPACITY
NEW SCHOOL
- YEARS -

BUILDING GROWTH

CONSTANT

SOURCE: ADAPTED FROM THE METROPOLITAN SCHOOL BOARD FOR STUDY OF EDUCATIONAL FACILITIES, P. 25.

Figure 15

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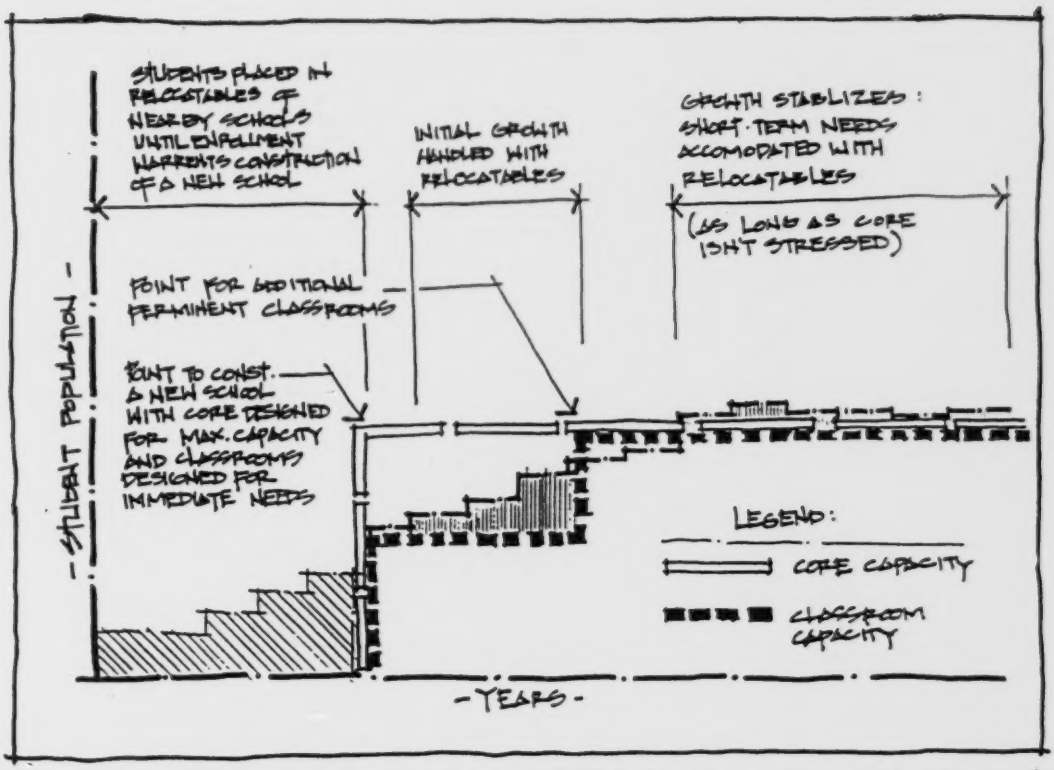
STUDENTS PLACED IN RELOCATABLES OF NEARBY SCHOOLS UNTIL ENROLLMENT WARRENTS CONSTRUCTION OF A NEW SCHOOL
INITIAL GROWTH HANDLED WITH RELOCATABLES
GROWTH STABLIZES: SHORT-TERM NEEDS ACCOMODATED WITH RELOCATABLES
(AS LONG AS CORE ISN'T STRESSED)
POINT FOR ADDITIONAL PERMANENT CLASSROOMS
POINT TO CONST. A NEW SCHOOL WITH CORE DESIGNED FOR MAX. CAPACITY AND CLASSROOMS DESIGNED FOR IMMEDIATE NEEDS
- STUDENT POPULATION -
LEGEND:
CORE CAPACITY
CLASSROOM CAPACITY
- YEARS -

BUILDING GROWTH

STEADY WITH STABILIZATION

SOURCE: ADAPTED FROM THE METROPOLITAN SCHOOL BOARD FOR STUDY OF EDUCATIONAL FACILITIES, P. 25.

Figure 16

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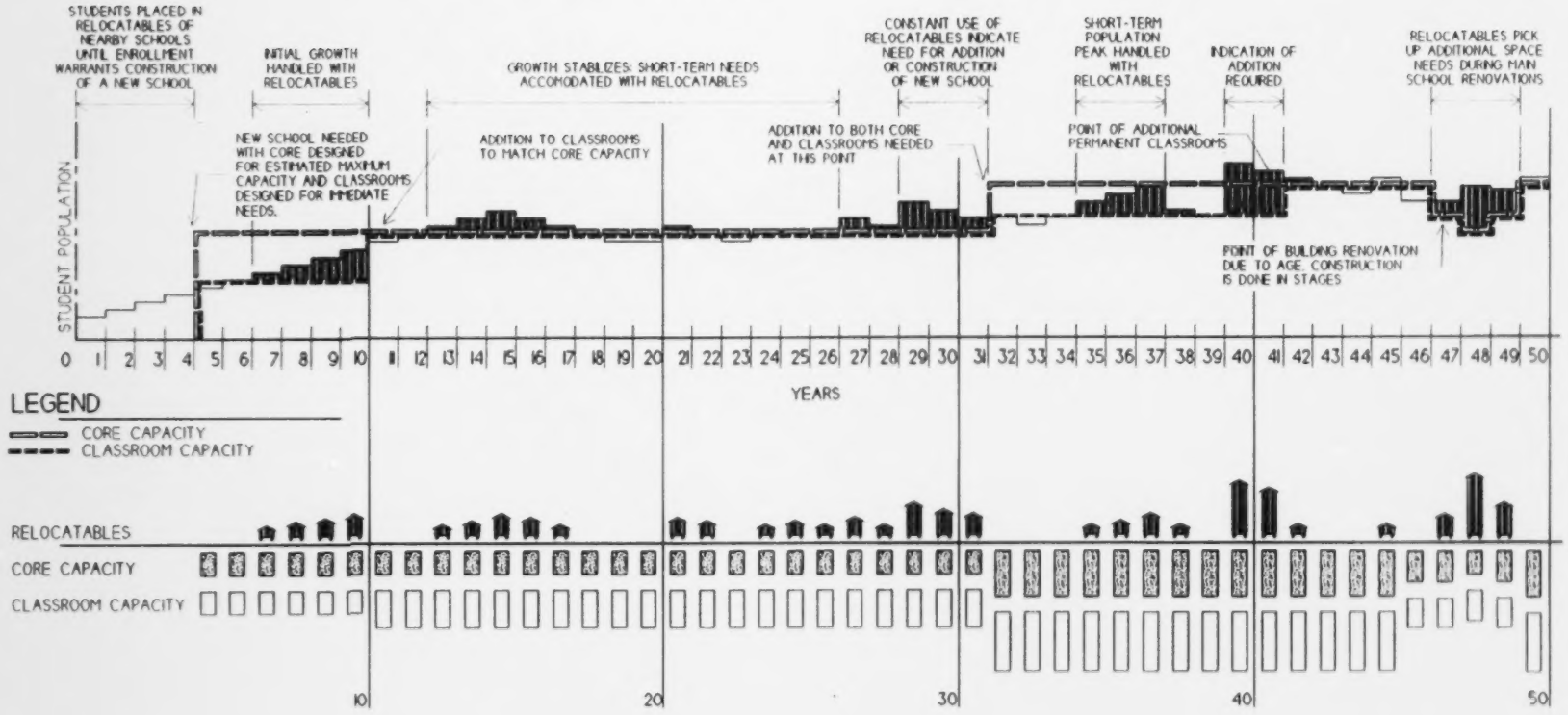
STUDENTS PLACED IN RELOCATABLES OF NEARBY SCHOOLS UNTIL ENROLLMENT WARRANTS CONSTRUCTION OF A NEW SCHOOL
INITIAL GROWTH HANDLED WITH RELOCATABLES
GROWTH STABILIZES: SHORT-TERM NEEDS ACCOMODATED WITH RELOCATABLES
CONSTANT USE OF RELOCATABLES INDICATE NEED FOR ADDITION OR CONSTRUCTION OF NEW SCHOOL
SHORT-TERM POPULATION PEAK HANDLED WITH RELOCATABLES
INDICATION OF ADDITION REQUIRED
RELOCATABLES PICK UP ADDITIONAL SPACE NEEDS DURING MAIN SCHOOL RENOVATIONS
NEW SCHOOL NEEDED WITH CORE DESIGNED FOR ESTIMATED MAXIMUM CAPACITY AND CLASSROOMS DESIGNED FOR IMMEDIATE NEEDS.
ADDITION TO CLASSROOMS TO MATCH CORE CAPACITY
ADDITION TO BOTH CORE AND CLASSROOMS NEEDED AT THIS POINT
POINT OF ADDITIONAL PERMANENT CLASSROOMS
POINT OF BUILDING RENOVATION DUE TO AGE CONSTRUCTION IS DONE IN STAGES
STUDENT POPULATION
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
YEARS
LEGEND
CORE CAPACITY
CLASSROOM CAPACITY
RELOCATABLES
CORE CAPACITY
CLASSROOM CAPACITY
10
20
30
40
50

Figure 17

THE USE OF RELOCATABLE CLASSROOMS IN A HYPOTHETICAL SCHOOL SITUATION

SOURCE: ADOPTED FROM THE METROPOLITAN SCHOOL BOARD FOR STUDY OF EDUCATIONAL FACILITIES, PAGE 86

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more easily withstand the storm, the lighter portable construction was heavily damaged and more subject to collateral damage."

7. Are current fire and life safety codes relating to the construction and set up of relocatable classrooms sufficient to protect the occupants and surrounding permanent buildings?

When school district officials were asked the question, "In your district, has there been loss of life or severe injury to a student, faculty or staff member, or visitor that can be associated with a relocatable classroom there was not one district out of the 57 districts responding mentioned any occurrence. When asked about if there was severe damage as a result of fire in a relocatable building, 88 per cent reported no occurrences. Ten per cent of the districts reported loss of a unit due to a fire. All of the buildings that did have damage were unoccupied when they burned.

From the site visits instances where relocatable units appeared too close to each other were discovered (a detailed investigation of the wall assemblies and percentage of openings of those facilities would need to be determined to gauge if the location created any type of fire hazard). When relocatables are constructed of non-combustible materials and the walls adjacent to each other have minimal openings these distances can get smaller. Other studies on this recommend the distance between relocatables be from 10 to 15 feet and 15 plus feet from the existing permanent buildings. Upon completion of our site visits it was determined that the majority of relocatables met life safety codes. The requirement for two exits for each relocatable classroom, the minimum distance of travel and the fact that generally each unit empties to the outside allows occupants of the classroom the ability to get to a safe place in the event of a fire. Providing an adequate distance between the relocatable and other units and the school proper allow for safe

egress, a greater distance for the fire to travel, as well as adequate room for fire equipment in the event of a fire.

8. Can the requirement for relocatable classrooms be met using other means not presently in use by the districts?

Districts can institute format changes such as year-round education, re-allocation of pupils to other schools, double sessions, changing grade-facility configurations, and adjusting school boundaries. They can decide not to do anything and simply overcrowd existing classrooms. They could also re-utilize or increase space in their existing facilities through additions, renovation and remodeling. Permanent structures such as commercial facilities, community buildings, i.e., libraries, gymnasiums, and churches, can be used through leasing arrangements. When facility planners were asked what other alternatives they considered to meet the requirements now being satisfied by relocatables they listed some of the alternatives mentioned above. One district considered a faster building program. Another considered the modular school concept currently being used in Orange County. However, 37% of the districts responding to the questionnaire had no response or reported not using any other means except relocatables.

9. Is there a measure of how relocatable classrooms affect the learning of students?

The evidence from the literature review is clearly in support of the belief that the physical environment of the classroom impacts students behavior and possibly their learning and well-being. Using this information as a framework and then evaluating the relocatable based on teacher opinion and from site-visits, a series of concerns was revealed. As mentioned at the beginning of the summary there are a variety of

relocatable configurations, types, styles, features, ages, and conditions. What is concluded here are those characteristics of the relocatable classroom that help to create or cause to destroy an effective educational environment.

Responses to the questions on the teachers survey pertaining to physical space suggested that the layout and design of the space as well as ceiling heights, were suitable for teaching. The most common space layout is a rectangle 24' X 32'-40'. Another space layout is the narrow 14' x 40'-56'. A third type is when a 12' or 14' module is joined together with other divisables to create a larger space. An important aspect of classroom design is that the space is flexible enough to allow for a variety of classroom arrangements, use of support equipment and teaching technologies. The typical rectangular layout allows for this flexibility. However, there appears to be a strong level of dissatisfaction among those teaching in the narrow relocatable. This perhaps is a result of the difficulty of creating spatial options, seating arrangements and special activity areas. What is missing from all of the spatial layouts are areas integral to the design that provide places for children to be alone or work in a small group i.e, an alcoves, bay window, porch area, an aspect that could perhaps be more actualized in a relocatable than in a site-built traditional space.

The overall lighting conditions in the relocatable appears to be adequate for reading and other demanding tasks and lend to a pleasant learning environment, according to a majority of classroom teachers throughout the state. The absence of windows in some relocatables also does not appear to be a problem for most teachers. However, twenty seven percent of the teachers did agree that the lack of windows creates an atmosphere that is not conducive for efficient and effective learning. Studies of windowless classrooms have not found a consistent pattern to pass judgement that this

environment is detrimental to student cognition and learning. However, there is evidence that demonstrates that student aggression increases in these environments, as well as teacher frustration (Romney, 1975). Recent studies have also found that lighting systems are not neutral and that they have non-visual effects on people. Those exposed to ultraviolet full spectrum lights that simulate natural lighting had fewer dental caries, demonstrated the best attendance, the greatest gains in weight and the best academic achievements than did those who did not receive supplements (Hathaway, Hargreaves, Thompson, Novitsky, 1992). Also important to a effective lighting environment is the ability to vary the lighting for different tasks and different individuals learning styles. Future designs for lighting could include zoned ceiling lighting configurations. From site visits we observed that the lighting levels were generally the required foot candles required in 6A-2 building code.

The acoustical environment was determined by most teachers to be adequate for teaching. However, results indicate that a problem exists with respect to the level of noise emanating from the package terminal air units in existing relocatables (the problem was most noticeable in older units). This problem requires teachers to raise their voices to compete with the sound coming from the air units. One teacher reported that she was hoarse by the end of the day for having to raise her voice all day. Students must also raise their voices to be heard. Students with hearing disabilities that rely on hearing-aids have problems because the hearing-aids amplified the mechanical sounds, making hearing desired sounds difficult. Fourty five percent of the teachers reported that outside noise was more of a problem than what is experienced in the permanent classroom. This response could be the result of placing the relocatables closer and to play areas, or

highways. Another possibility is a relocatable not having adequate acoustical sound barriers and buffers built into the walls, roof and floor.

The majority or teachers reported that the thermal environment of the relocatable was adequate. One of the advantages of the relocatable is the ability to control the environment independantly at the classroom level. Many permanent classrooms generally are controlled by a larger system with teachers being unable to control their individual environment. Being able to open windows, or regulate the temperature and air movement is important for creating a effective, comfortable learning environment. Of concern to us is the "off-gassing" of new materials used in the relocatables. In the new relocatables, noticed on our manufacturing site visit, carpets and wall paneling contained heavy odors that need to be examined as to their toxicity before exposing children. Procedures for "off-gassing" need to be considered.

Most teachers, when responding to the effects of the aesthetics of the relocatable, agreed that the visual appearance was a not a factor in their attitude toward teaching.

Their does seem to be a perceived problem regarding discipline management in relocatables as compared to permanent classrooms. Physical environment does affect behavior and from studies, listed in the literature review, more positive attitudes and behavior may eventually result in improved student achievement. Problems associated with negative behavior in the relocatable could result from a variety of the environmental conditions already mentioned. The teachers response to the questionnaire suggests that smaller units exacerbate this problem. One possibility is the image that the relocatable portrays to the student. If the physical design is sterile and unattractive and isolated from the main school the student may be reacting to this environment indirectly through aggressive behavior.

It must be mentioned here that the problem with an opinion poll is that many teachers lack environmental awareness of their classrooms. This "environmental numbness" (Weinstein, 6/1980) of teachers makes it difficult to rely on the teachers questionnaire solely for determining how the relocatable classroom affects student learning. To adequately answer question 9 an empirical examination of the effect of the relocatable environment on the educational progress of its occupants must be conducted involving controlled settings, test score evaluations, and behavioral observations.

10. What is the cost of relocatable classrooms as compared to permanent construction? AND,

11. What is the cost of maintaining relocatable classrooms?

Questions 10 and 11 directly request information regarding the relative costs associated with relocatable classrooms versus permanent classroom structures. The costs associated with each type of project may be separated into four distinct categories: initial capital outlays, operating, maintenance and replacement costs. A description of each of these categories, how the relevant data was obtained and what the level of costs are for each of the facility types is given below. Also given is a description of the costs specific to relocatables i.e. the transportation, connection and disconnection costs associated with moving a relocatable.

With respect to the initial construction cost of a permanent addition (common classroom), information obtained from a sample of recent district level addition projects from around the state indicate that on average the total cost per square foot runs approximately $61.00. Information gathered from a survey instrument and personal

interviews with district level school planners shows a range of per square foot purchase prices for relocatables running any where from $22 to $47.

Operating costs (direct energy consumption) for a permanent common classroom structure have been shown to average approximately $1 per square foot on an annual basis. For a low-end relocatable the comparable annual operating costs run within a range of $1 to $1.20 per square foot of space while those for a mid- or high-end relocatable run from $1 to $1.10.

Maintenance costs, which include the annual expected expenditures for normal preventive and replacement maintenance, have been shown to be approximately $2.30 per square foot for a permanent classroom addition, $2.50 for a high-end relocatable and $2.75 for a low-end relocatable. The use of higher quality materials are the primary reason for the disparity in costs between each type of structure.

Normal refurbishment and replacement costs for items such as HVAC units, roofing, exterior finishes, carpeting, etc. are expected to be approximately 36% higher for relocatables than for permanent structures with total costs over a 30 year period of $15,275 for a relocatable and $11,167 for a permanent structure.

The table given (See Figure 18) provides a description of the relevant composition of each cost component over the 30 year life cycle for the two types of structures. This information is based on the cost schedule of a low-end relocatable at its break-even price of $19 and under the assumptions of annual operation/maintenance costs of $3,950. As is evident from the table, approximately 70% of all costs associated with the use relocatables come from the operating and maintenance expenses incurred, suggesting that the use of these units in effect shifts some of the burden off of the capital end of the budget. This may or may not be an optimal situation for some districts as their sources

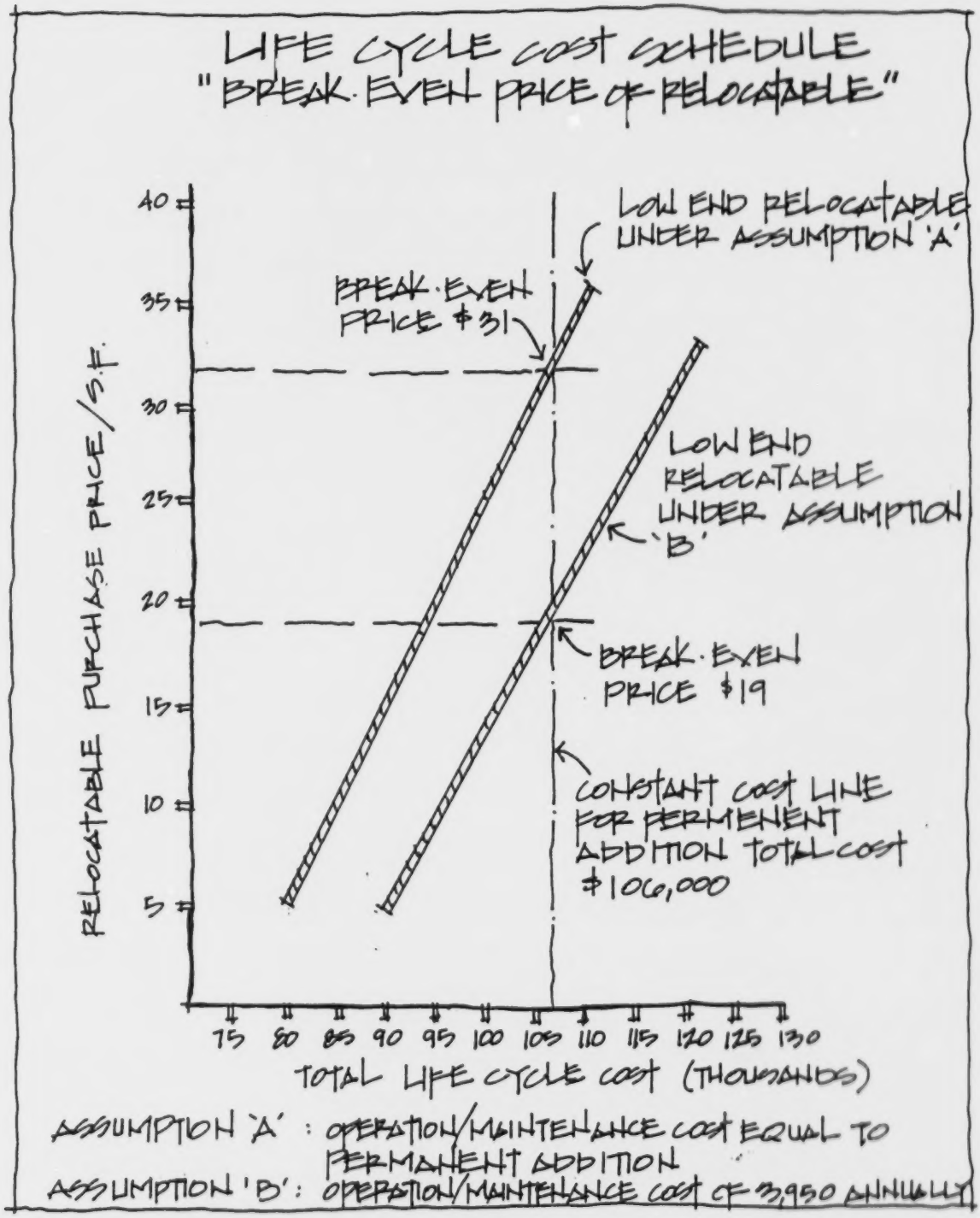

Figure 18

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of operating revenues may be in a tighter position as compared to the availability of capital investment funds.

Comparative Composition of Cost Schedules

	Permanent	Relocatable
Capital Outlay	46.7%	20.1%
Operations./Maint.	48.1%	70.0%
Refurbishment	5.2%	8.9%

Table 2

12. What are the costs of relocating these portable classrooms?

Relocatable Specific Costs

Since relocatable classrooms can be moved from site to site there are moving costs associated with their ownership which do not exist for permanent structures. The mobility is certainly seen as an asset by district planners and is a major reason thatrelocatable classrooms are becoming so popular. With the demands required in meeting unpredictable shifts in enrollments rising, relocatable classrooms offer a great strategic advantage over permanent structures in alleviating short-term accommodation problems. Each fall local officials scramble to accommodate unexpected enrollment levels in some schools and experience unexpected shortfalls in enrollments in others. This intra-district mismatch in enrollments leads to a need for quick solutions which relocatables provide by being able to be relocated in a short time frame.

There are of course associated costs each and every time a relocatable is moved. These costs can generally be categorized into three distinct elements; direct physical moving costs, disconnection costs and connection costs. According to information provided by respondents to the district surveys collected; the average physical moving costs run approximately $2,068, average disconnection costs run approximately $600 and average connection costs run approximately $2,275. Summing these costs gives an average total relocation cost of $4,943. While moving costs associated with relocatables have no effect on the capital end of district budgets they do have very important implications within the operating budget. In today's environment where most Florida school districts are topped out on taxing capacity and Amendment 10 restrictions will saddle growth in their local tax bases, any factors raising the demand for annual operating funds merit serious attention.

13. What additional costs are included in the initial construction of a relocatable classroom to make it moveable?

From a review of construction documents, visits to manufacturing plants and listening to industry representatives it appears that there are very little costs, if any, associated with the initial construction to make the relocatable classroom moveable. Construction of the relocatable, even though in a controlled setting of a manufacturing plant, is still similar to standard construction and details used in site-built facilities. There are some costs involved in making the relocatable capable of withstanding the structural demands of over-the-road transportation. However, these design features also make it better able to handle possible high wind factors that may occur at the school site.

14. What would be the cost effectiveness of requiring all new relocatable classrooms being constructed utilizing fire resistant materials?

As reported in Question 7 there is very little evidence to support a requirement for classrooms to be constructed out of fire resistant materials for safety reasons. There would be some cost effectiveness using fire resistant materials because of the ability to place the units closer to each other minimizing land impacts and costs. This requirement would be more important to schools located in urban areas where land areas are at a minimum and costs are at a premium. Also, units (divisables) could be planned to fit together as larger building areas or if constructed out of fire resistant materials. Divisables, however are more costly to relocate than portables so the cost effectiveness saved by eliminating some of the exterior walls would be offset by the costs of relocation. Industry representatives reported that the cost for relocatables to be constructed of non-combustible construction is 36% and/or $22-25 per square foot more than standard portables.

15. What is the cost per usable year when compared to permanent construction?

This question seeks for a comparison of the costs per "usable year" for relocatables verses permanent structures. There are two distinct ways this question can be viewed and answered. First, one can compare the expected annual maintenance, operating and unit specific costs for each type of unit. With respect to these costs, it was shown in the "Results" section that from the data available there is no clear cut level of costs associated with relocatables. We were able to determine a range of costs for relocatables which run from being equivalent to those of permanent structures, approximately $3,300 annually, down to $8,950 for a low-end relocatable (with annual

operating/maintenance costs of $3,950), assuming that a relocatable is not moved more than once per year. These cost figures are heavily dependent on the number of times a relocatable is moved as each move represents a cost of approximately $5,000.

The second way of interpreting this question is to take the average expected annual costs for each type of structure from the Life Cycle Cost figures. While this method does take into account all expected costs inclusive of initial capital outlays and any refurbishment costs it does not take into account any moving costs associated with a relocatable. The cost analyses showed that a relocatable can have the same, lower, or higher annual costs as compared to a permanent structure depending on the purchase price of the unit. As an example, for a low-end relocatable with annual operating/maintenance costs of $3,950 that was purchased at a per square foot price of $19 (its break-even price) the average expected cost per usable year for each type of structure would be approximately $3,530. If instead the purchase of the relocatable were $30 per square foot, the expected annual costs of the relocatable would become $3,890.

It should be noted that these cost estimates will necessarily be lower in comparison to those given in the first section due to the discounting of future costs over the life cycle time horizon and the exclusion of relocation expenses.

16. Taking into consideration their life expectancy, required maintenance, and cost to relocate, are portable classrooms a good investment?

Question 16 hits at the crux of the problem currently faced by both state and local policy makers. As local districts around the state continue to experience growing demands to meet both rising levels of aggregate enrollments as well as unpredictable

intra-district shifts across individual school enrollments at a time when sources of capital revenues are in short supply there may be a tendency for these districts to grasp for the quickest solution to their student housing problems. In a growing number of instances this solution takes the form of employing capital funding to lease or purchase relocatable classrooms rather than construct new permanent classroom additions. The question that results from this dilemma is whether the growing reliance on the use of relocatables is indeed the most cost efficient cure for the problem at hand. The answer to the question of whether relocatables are indeed a good investment and wise use of scarce capital funds is unfortunately a very broad and subjective topic.

Our approach in this study has been to perform Life Cycle Cost analyses of the comparative costs over a 30 year period for each type of student housing structure, accounting for the life expectancy, required maintenance and operating costs as well as periodic refurbishment outlays. There is one major point that need be kept in mind when trying to determine which type of structure is the most cost efficient use of funds. This point is that a relocatable is essentially a permanent structure until the time it is relocated. Any comparison of the two types of classroom facilities must be formulated by assuming that the relocatable will not be moved (to not do so would inaccurately suggest that the ability to be relocated is a liability instead of an asset to relocatables classrooms). Thus, in our financial analyses no annual relocation costs enter the picture. The only time these costs would be relevant is if a district were trying to decide whether to build a new permanent addition at a given site or move an existing relocatable to the site instead. Even in this case, only the initial move should be considered.

The results of the various financial analyses do not allow conclusions to be drawn as to whether the current use of relocatables as a whole is a good investment or not, but

do provide evidence at the individual unit level. The results do provide estimated square foot break-even lease or purchase costs for relocatables which assure that they are at least as "good" an investment as a permanent classroom addition. The whole question of cost efficiency hinges on the leasing or purchase price of the relocatable, making the question not one of whether relocatables are a "good" investment but rather one asking "at what price." With this information, policy makers can determine whether a proposed lease arrangement or purchase price of a new relocatable will insure that it is a "good" investment or at least as "good" an investment as a new permanent addition by if the purchase price lies at or below the break-even price. A graphical description of these conditions is given thiss section of this report, See Figure 18. The baseline results, holding the cost of capital funds at 6.75% (municipal bond rate) and expected annual inflation of 3.5%, indicate that the break-even per square foot price for a low-end relocatable with annual operating and maintenance costs equivalent to a permanent classroom addition is approximately $31 while that of a unit with annual operating costs of $1,200 and maintenance costs of $2,750 is $19. For the mid- to upper-end category, the break-even price of a unit with operating and maintenance costs equal to those of a permanent classroom addition was calculated to be $37 and that of a unit with annual operating costs of $1,100 and maintenance costs of $2,500 at $30.

Due to the continuation of high rates of growth in public school enrollment levels in many of this state's school districts and the expected weakness in these district's fiscal position, the use of relocatable classrooms will certainly continue to expand during

upcoming years. The information in this report has shown that these structures can be just as educationally effective and cost efficient in the long run as permanent classroom additions when appropriately viewed.

This study has found that the primary advantages of the relocatable classroom are its ability to provide flexible, suitable short-term accommodation for Florida's growing student population and its ability to provide that accommodation incrementally, in a timely and cost efficient fashion.

The research has also shown that there are substantial costs associated with the relocation of these units and that these costs will necessarily place higher demands on local operating revenue sources as compared to permanent fixed structures.

The growing reliance on portable classrooms as a means to meet enrollment expansion needs is in effect shifting some portion of the financial burden for the housing of new students from the capital outlay to the operating end of the budget. This may or may not be a desirable consequence depending upon the relative ease with which the burden can be accommodated. Unfortunately, the scope of this research did not seek to provide any insight into this facet of the use of portables. This is a very important issue in the context of evaluating whether the growing use of these structures is a financially prudent trend and one that certainly merits further investigation.

Following the high sensitivity of the life cycle costs to relatively small changes in the level of operating and maintenance costs observed it is suggested that a great deal of attention be given to choosing the values used as a baseline for comparison. This choice can have a very large impact on any resulting policy decision. It is also suggested that further research needs to be carried out to more accurately determine the true value for these cost parameters. One method of accomplishing this would be to perform actual

case studies over a set of existing structures and employ this information to estimate the expected costs.

A probing question evolving from this study is why is the quality of the architectural design of the relocatable so dissimilar and often inferior to that of the traditional site-built structure? From our review of the manufacturing industry and construction technologies it is clear to us that it is possible to construct a facility that has similar if not superior architectural qualities to permanent facilities. Furthermore, since the life expectancy for relocatables appears to exceed 20 years, better designs could perhaps exceed 40 years. This makes the relocatable classroom a permanently used facility within the district. However, as mentioned in some of the studies and confirmed from our own observations, "the development of the portable classroom has been disappointing when measured by any yardstick of design standards"(California, 1969). "Most relocatable structures currently in use have been stripped of amenities, ostensibly for the sake of economy. In many communities bad taste or no taste at all have been actively chosen over good taste in the belief that 'the pubic won't stand for our putting a lot of money into fancy frills.' It is understandable, then that community reaction to the first appearance of those gray sheds sitting out in the school yard is usually negative. The inspirational effect on the student entering day after day, or year after year, can hardly be much different" (EFL, 1964). The question remains, why are there two standards of quality for the design of educational facilities within the State of Florida? If our permanent schools were designed according to the same architectural qualities of the relocatable, our communities would be up in arms. The educational facility is part of the public domain and has historically presented

itself within the community as a neighbor and friend, not as an intruder or unwelcome guest. This last concern introduces the final part of this report which gives recommendations and suggestions for further research.

RECOMMENDATIONS

"...The style of the exterior should exhibit good, architectural proportion, and be calculated to inspire children and the community, generally, with respect for the object to which it is devoted. It should bear a favorable comparison, in respect to the attractiveness, convenience and durability, with other public edifices instead of standing in repulsive and disgraceful contrast with them." Henry Barnard, School Architecture, 1842 quoted from Relocatable School Facilities(1964), p.14.

1. The design qualities and appearance of the relocatable classroom must equal or exceed the design qualities and appearance of our finest schools.

This will not take place until attitudes change concerning the permanent use aspects of the relocatable classroom. Our current situation is not unlike the situation in California 25 years ago. "Portable classrooms became an over-the-counter commodity in a highly competitive and lush market...Competition based on price alone tended to hold down the quality level of portable classroom designs...A few designs, most of them similar in basic concept, became the 'stock plans' of the portable classroom industry. Continued fierce competition has tended to prevent major design changes or improvement in these facilities" (Gibson & Claire, 1968).

There should not be two standards of architectural quality for the educational facilities of Florida. The relocatable is permanently used as a educational facility

somewhere in the district and should be equivalent in architectural quality to those facilities that are permanently fixed-in-place. Though this study does not recommend that the State of Florida, Department of Education control the decision making process of districts in their acquisition of relocatable classrooms it does recommend that the Department direct the districts through policies that will insure that the architectural qualities of all facilities in the state are at a consistently high level. The implementation of a statewide performance and design quality specification for relocatables would help insure that districts would not reduce the quality of relocatable facilities to get a cheaper unit price (perhaps updates in the 6-A2 regarding exterior finishes and trim would be helpful as a first step). This would also allow manufacturers to improve the usable life and quality of the facility making it more comparable to conventional facilities. The use of marginal design specifications for relocatables should not be allowed by any district.

2. The location of relocatable classrooms on the school site should be master planned at the time the architect is preparing the architectural plans for a permanent school building. At the same time, underground utility connections should be planned and positioned during the construction of the permanent facility for future additions and future use of relocatable classrooms. Included in this master plan should be the design of a covered walkway system that is integral to the design of the new facility being planned.

Most of the problems with the siting of relocatables could be solved by requiring the architect to master plan not only the location of future additions but the location of relocatable facilities. A suggestion would be for relocatables to handle 10% over population (capacity of the school). This would allow a professional trained in site

planning to develop the locations of relocatables and give those now making the siting decisions, who may have very little knowledge about site design, a plan for their locations. In addition, the master planning and installation of underground utilities for future connections would decrease the amount of cost for future hookups of relocatables and eliminate the need for the unsightly overhead wiring. The design by the architect of a future covered canopy system integral to the architectural design of the school proper that extends into the areas of the relocatables would not only provide a protected walkway system for students and teachers who would use the relocatables but would also provide a strong visual, physical and emotional link to the relocatable and the rest of the campus.

The reader who is interested in recommendations from other studies on relocatables can turn back to the end of Chapter 2.

The following are suggestions for further research and dialog on the subject of relocatable classrooms.

A. Establish a task force made of FDOE staff, facilities planners, superintendents, architects, manufacturers and dealers to explore administrative procedures, acquisition issues and performance specifications regarding the use of relocatables. This would include issues such as timely plan reviews, in-plant inspections and changes to 6-A2.

B. Develop a Guidebook for architects and planners on the use of relocatables at a school site. This Guidebook would include master planning alternatives, rows vs. courtyard plans, requirements for locating and relocating a portable classrooms, landscaping ideas, canopy designs (taking into account the moving considerations of the facility), utility requirements, etc.

C. Conduct further research in the area of maintenance and operating expenses for relocatable classrooms.

D. Develop a state life safety requirement for relocatables similar to the National Fire Protection Association, Life Safety Code NFPA 101. Information from state and local fire officials and NFPA members would be necessary.

E. Consider a state wide policy to retire or renovate all relocatables that do not provide adequate natural light and/or ventilation and all narrow 14' wide units.

F. Establish criteria for maximum levels allowable for sound from mechanical systems that will not interfere with teaching and learning. This would require research on motor noise, air velocities, placement of systems in the room etc. along with teacher and student experiments.

G. Review current inspection policies of districts regarding their relocatables, especially those relocatable that remain in place for over 5 years.

H. Organize a design competition open to all graduate students of architecture and architects with less than 10 years of experience. The goal would be to design a new relocatable classroom for Florida. The program would be developed out of the findings from this study and would be judged by a facility planner, architect, environmental psychologist, teacher, industry representative, and student.

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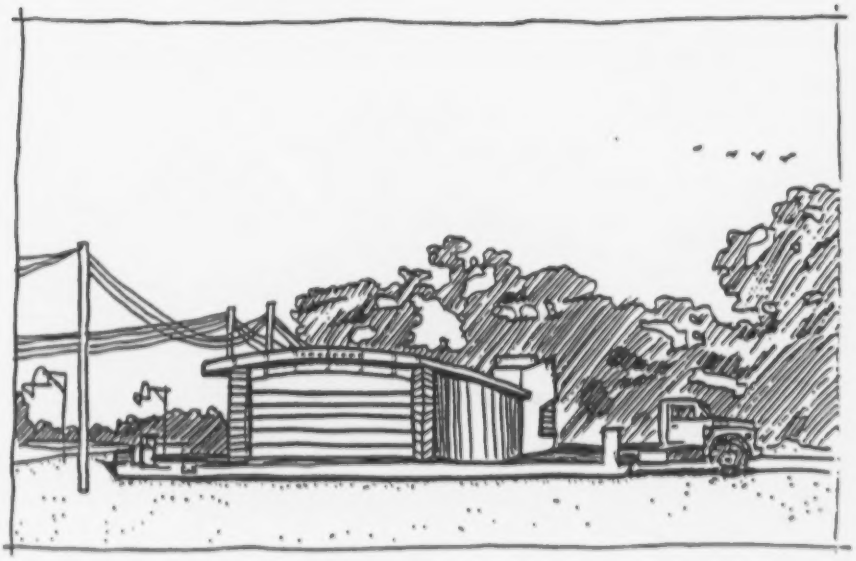
Images

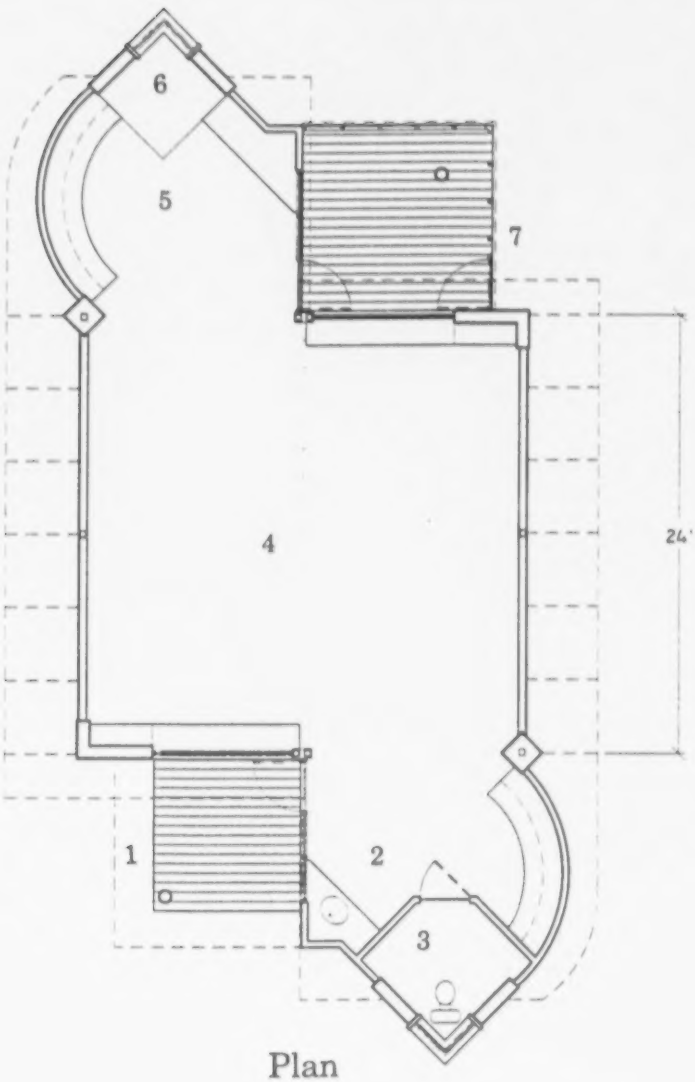
A New Prototype

- Floor Plan
- Elevations and Section
- 3D View
- Site Plans
  - Radial
  - Quad
  - Linear
- Computer Renderings
  - Outside Front View
  - Outside Side View
  - Outside Group View
  - Inside View

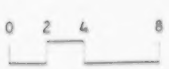


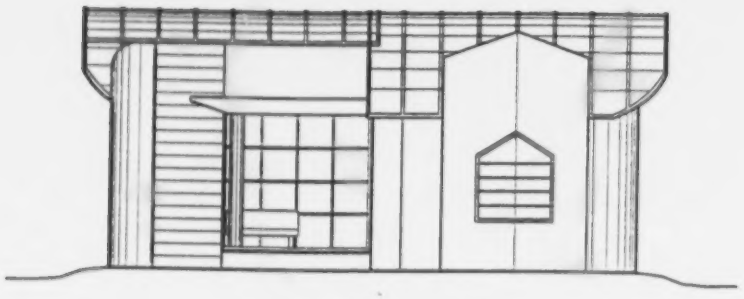
Current Portables in Florida

1 Entry Porch
2 Front Activity Area
3 Toilet
4 Group Area
5 Back Activity Area
6 Individualized Activity Area
7 Screened Porch

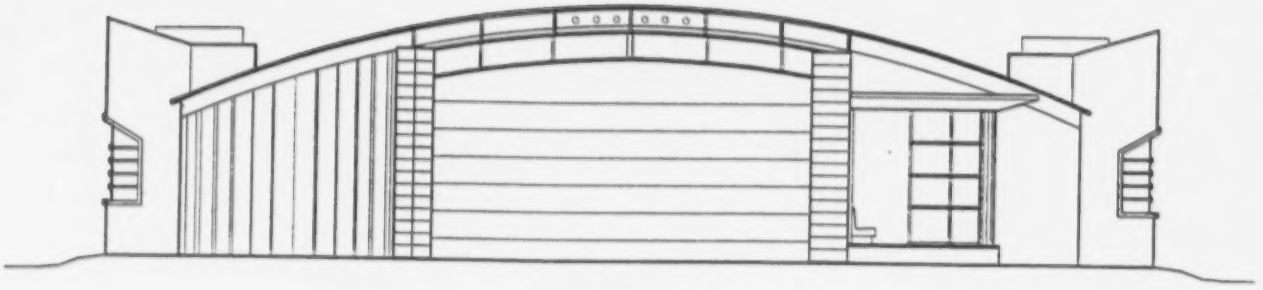


Plan

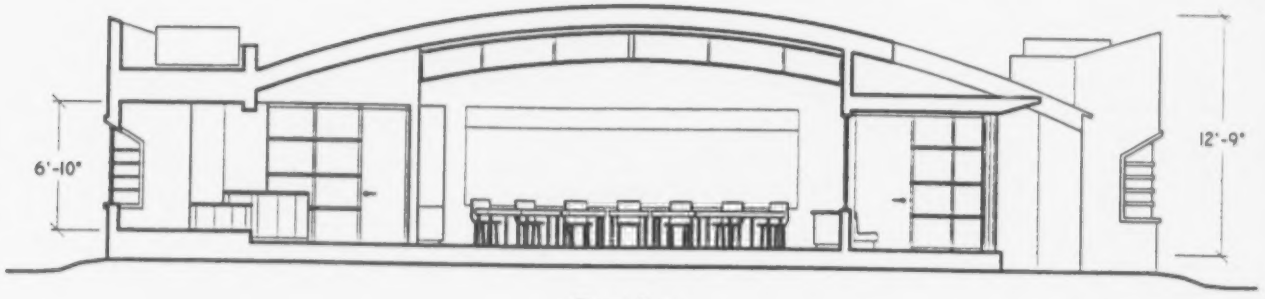




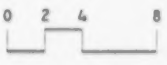
Front Elevation

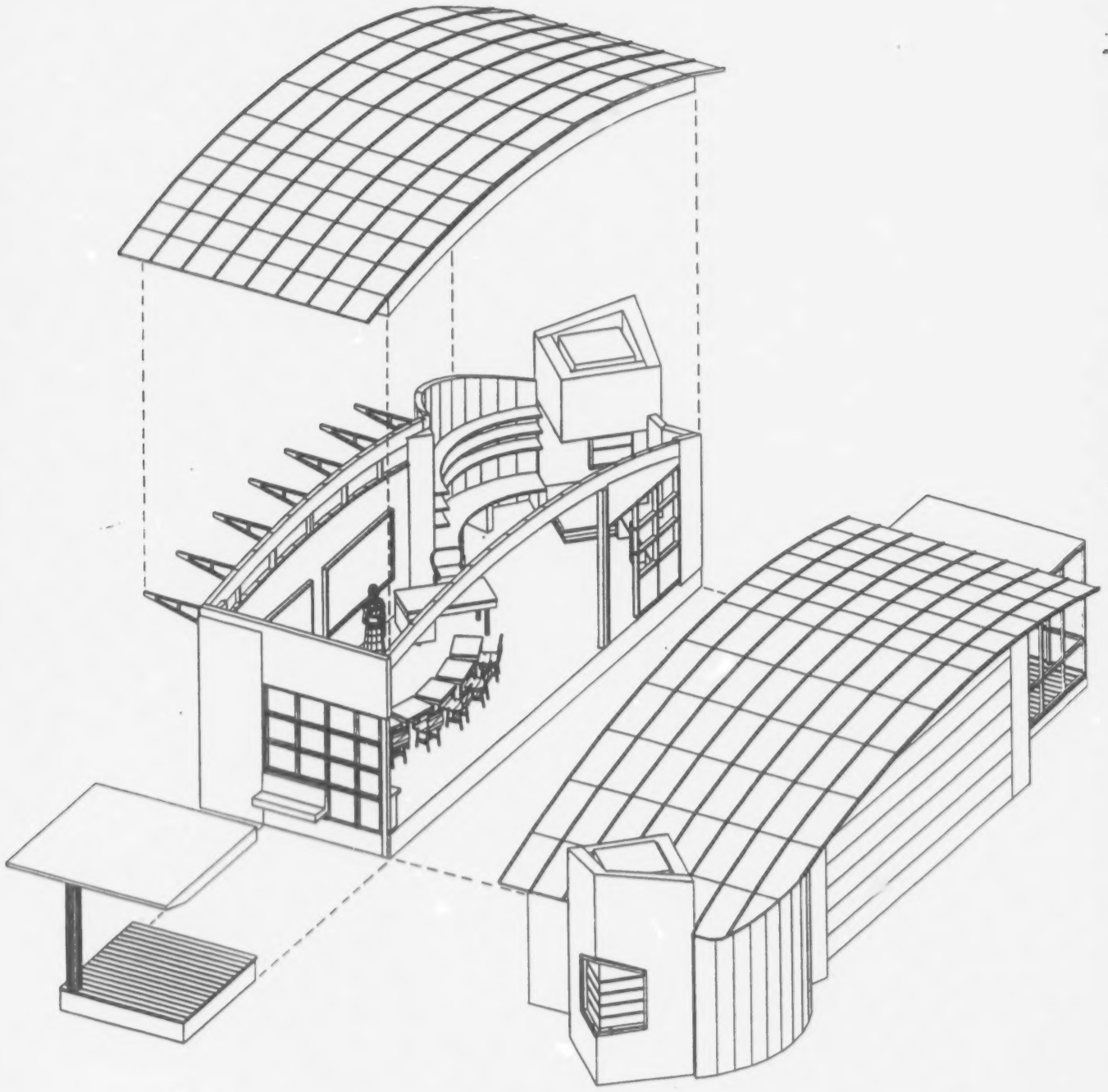


Side Elevation

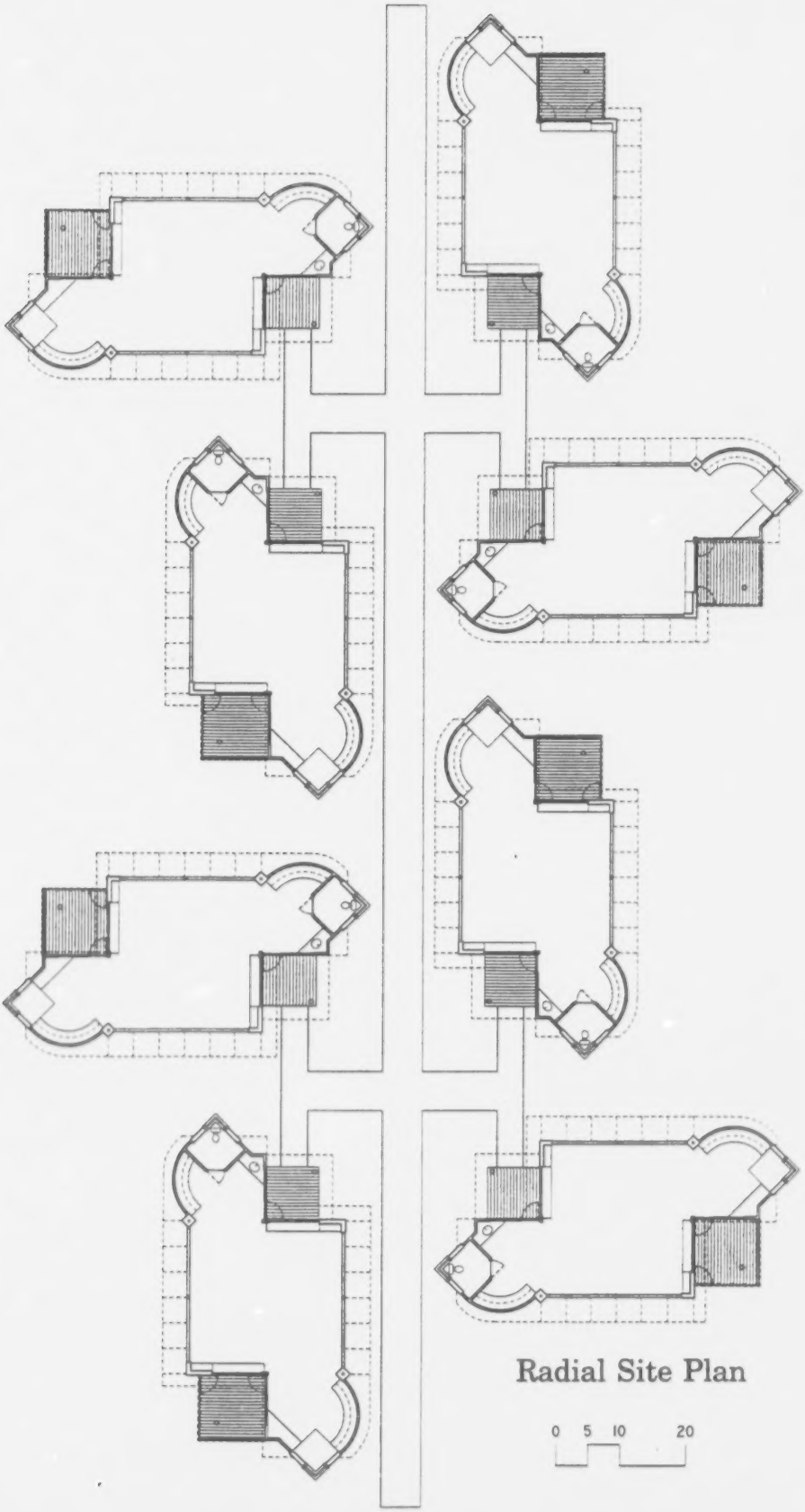


Section

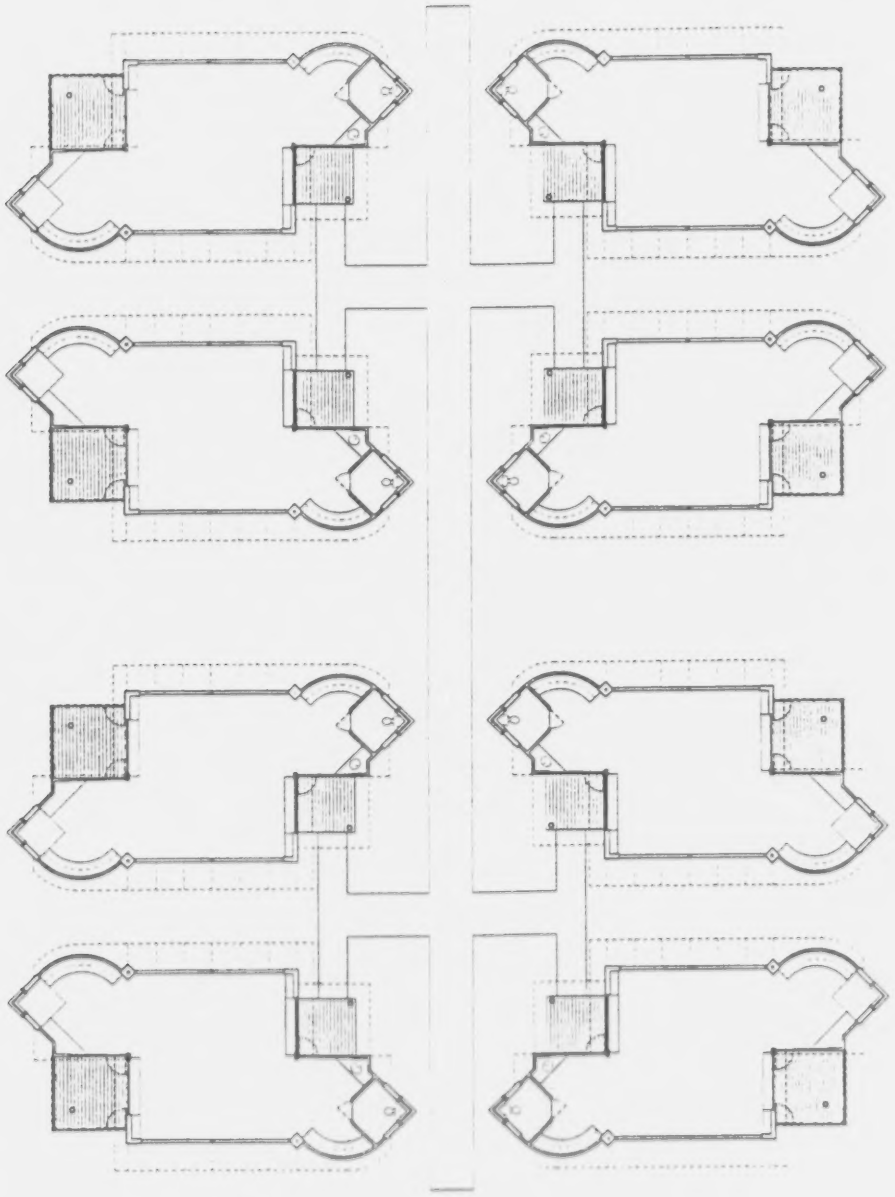




Exploded Axonometric

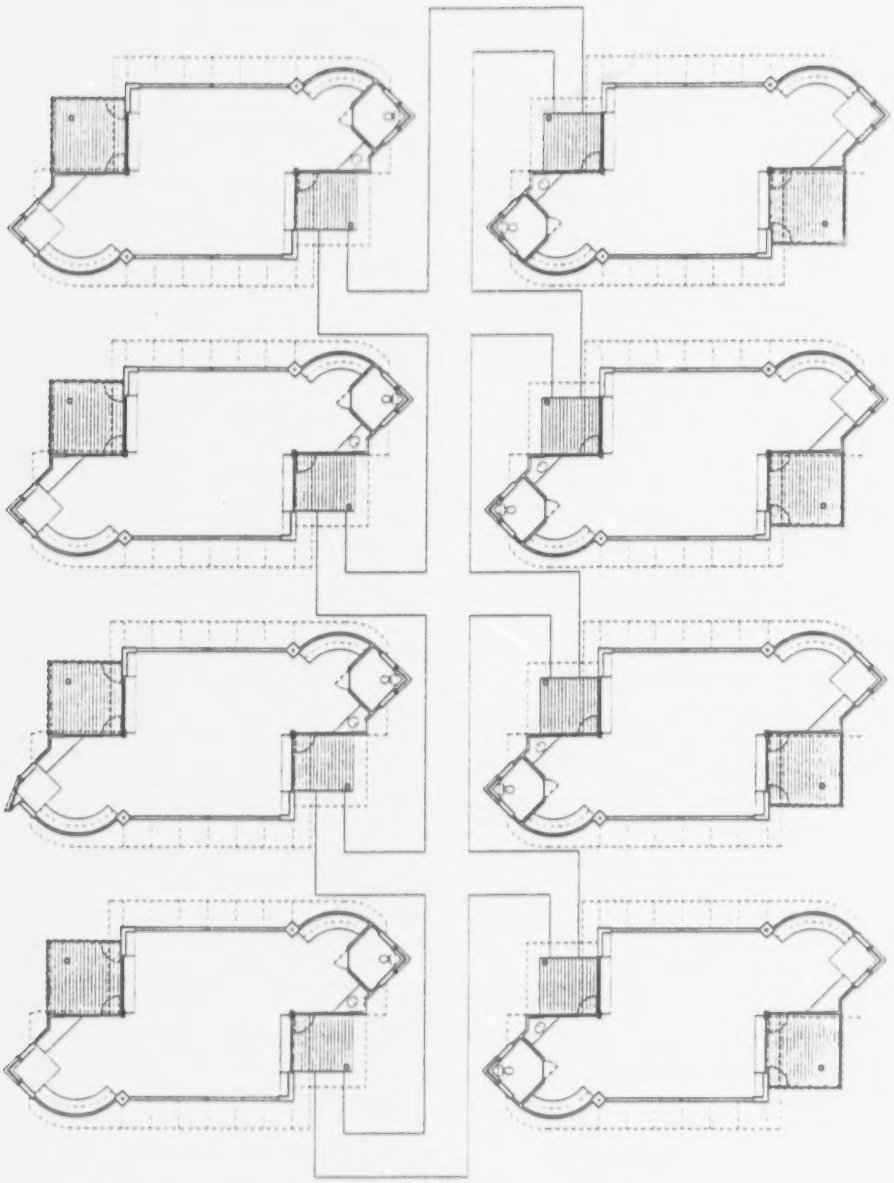


Radial Site Plan

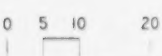


Quad Site Plan

0 5 10 20



Linear Site Plan



Appendix A

Return completed form prior to May 17, 1993 to:
Steve Cooke, Principal Investigator
Assistant Professor
University of South Florida
Center for Community Design & Research
3702 Spectrum Boulevard, Suite 180
Tampa, FL 33612
(813) 974-6019

FLORIDA DEPARTMENT OF EDUCATION
OFFICE OF EDUCATIONAL FACILITIES

THE USE OF RELOCATABLE CLASSROOMS

==========

Instructions

The Florida Center for Community Design + Research, located at the University of South Florida, has been selected by the Florida Department of Education, Office of Educational Facilities, to conduct a study to evaluate the use of relocatable classrooms in the sixty-seven Florida school districts.

The answers to the questions that follow are of great importance in order for the staff of the Center to analyze and report to the Department of Education the present use of relocatable classrooms. Please answer **all** of the questions.

If you have questions please feel free to contact Steven A. Cooke of the University of South Florida at 813-974-6019, or John A. Watson of the Department of Education, Office of Educational Facilities, at 904-488-1750.

==========

Questionnaire

District Name:_____ Date:_____

Person Completing Questionnaire:_____

Title/Position:_____

Phone # (SunCom if Available):_____

1. What is the reason(s) your School District generally chooses to purchase, construct, or lease relocatable classroom buildings? (Please give percentage)

   a._____% Shifting Enrollments (Your district has a mobile student population)

   b._____% Time Factor (Your district requires immediate student housing)

   c._____% Economy (It is the opinion of your district school board that relocatable classrooms are less expensive to buy or construct than permanent classrooms)

   d._____% Other _____

   100 % Total

State of Florida
Department of Education
Tallahassee, Florida
Affirmative action/equal opportunity employer

2. Other than relocatable classrooms, what other alternatives has your District considered to meet the requirements described in Question #1?

_____

_____

_____

_____

3. Please complete the following table to indicate the number, location, and ownership of all of the relocatable classrooms in your district.

School Center Type	Owned	Leased	Lease/Purchase	Other
(02)Pre-Kindergarten				
(03)Kindergarten				
(04)Elementary				
(05)Middle				
(06)Jr High				
(07)High Schools				
(08)Exceptional Ed				
(09)Combination				
(11)Adult Education				
(12)County Administration				
(13)Warehouse				
(14)Maintenance				
(15)Student Transportation				
(16)Food Service				
(17)CommunityEducation				
(18)Joint-Use				
(20)Vocational Technical				
(21)Other				
(22)In Storage (Not Being Used)				
Total Number of Relocatables				

4. How many relocatables does your district have on order, that have not yet been delivered, or under construction, that have not yet been completed?

On Order_____ Under Construction_____

5. What decision making process is used by your school district when it determines that a relocatable classroom should be bought, leased, or constructed?

_____

_____

_____

_____

_____

6. What design criteria is used by your school district when selecting a relocatable classroom?

7. Does your school district use the competitive bidding process when making the selection of relocatable classrooms?

Yes_____ No_____

8. Who in your school district makes the final selection of your relocatable classroom buildings?

9. How long (in years and months) does a relocatable classroom remain in use in your school district before it is replaced by another relocatable classroom or permanent construction?

10. What method(s) is used by your school district to determine when a relocatable classroom is no longer necessary and should be removed from service?

11. What are the specific reasons your school district would remove a relocatable classroom from active service?

12. What method is used by your school district to determine the life expectancy of your relocatable classrooms?

13. Based on your experience with educational facilities, specifically relocatable classrooms, what factors contribute to making a relocatable classroom stay in use longer than normally expected?

14. Does the intended use of the relocatable classrooms in your district change due to the condition of the unit over time?

Yes_____ No_____

15. How does your school district determine the longevity of permanent classroom space?

16. In your district, does the **use** of relocatable classroom space differ from the **use** of permanent classroom space? If yes, how and why?

17. At schools where relocatable classrooms are presently in use, how, and to what extent, are the following "core" areas adversely affected by the addition of relocatable classroom buildings to the school site?

Cafeteria_____

Auditorium_____

Library_____

Music & Art Rooms

Faculty/Staff Administration, Offices, Lounge Areas

Parking, Vehicle Access, Bus Loading and Unloading Areas

Playgrounds and Recreation Space

18. What is the wear and tear on these "core" areas from the placement of relocatable classrooms at the schools in your district?

Cafeteria_____

Auditorium_____

Library

Music & Art Rooms

Faculty/Staff Administration, Offices, Lounge Areas

Parking, Vehicle Access, Bus Loading and Unloading Areas

Playgrounds and Recreation Space

19. What is the overall impact on energy conservation programs in your district when relocatables are added to a traditional school core facility?

20. How often were your existing relocatable classrooms buildings moved during the following time periods? (Acquiring a new relocatable does not count as a move.)

a. Over a one year period (1992)

b. Over a five year period (1987-1992)

c. Over a ten year period (1982-1992)

21. What are the main reasons in your district for moving (relocating) a relocatable classroom building?

22. What is the primary consideration for where a specific relocatable classroom will be placed on a site in relation to existing permanent buildings?

23. Does terrain of site become an issue in the relocation of portable classrooms?

Yes_____ No_____

24. What individual in your district decides the exact location of your relocatables?

25. What are the basic relocatable classroom **types (styles) and sizes (capacity)** that are used in your school district?

26. Please list the names of the manufacturers from who you have purchased relocatable classroom buildings.

27. Please list the names of the companies from who you have leased relocatable classroom buildings.

28. What is the purchase price, per new unit, for a relocatable classroom by type, model, and manufacturer?

29. What is included in the initial cost?

30. Does the initial cost include first time set up?

Yes_____ No_____

31. What is the annual cost of leasing a relocatable classroom by **type and model**?

32. What is the average construction cost for a permanent classroom of similar size? (Do not use the square foot cost of construction multiplied by the number of square feet in the classroom. This will not give an accurate figure. Compare classroom addition instead of entire school.)

33. What policies and/or procedures does your school district use for relocating their existing relocatable classroom buildings?

_____

_____

_____

_____

_____

_____

34. Who moves your relocatables from one site to another? (If more than one individual or group performs this function, please indicate the percentage of the workload that can be attributed to each group.)

	Percent
School District Personnel	_____%
Private Contractor	_____%
Other_____	_____%
Total	100 %

35. On the average, how far are most relocatables in your district moved at any one time?

_____ miles

36. Is the distance of the move a factor in the cost of each move?

Yes_____ No_____

37. What are the transportation costs for:

a. the initial move $_____

b. for subsequent moves $_____

38. How does the <u>type</u> and <u>model</u> of relocatable classroom factor into the cost of the moving?

_____

_____

_____

_____

_____

_____

39. Please provide the following information pertaining to the **installation** of relocatable classroom buildings in your district.

a. $_____ Cost of site work, surveying, clearing, grading?

Who performs this work?

_____

_____

b. $_____ Foundation costs?

Who performs this work?

_____

_____

c. $_____ Access: Walks, ramps, railing, service drives?

Who performs this work?

_____

_____

d. $_____ Electrical power hookup costs including underground installation and exterior lighting?

Who performs this work?

_____

_____

e. $_____ Mechanical hookups including gas lines?

Who performs this work?

_____

_____

f. $_____ Plumbing hookup including new underground sewer and water and any additional systems required?

Who performs this work?

_____

_____

g. $_____ Landscaping costs?

Who performs this work?

_____

_____

h. $_____ Storm drainage and retention area costs?

Who performs this work?

_____
_____
_____

i. $_____ Agency Inspections?

Who performs this work?

_____
_____

40. What are the types and costs of permits, impact fees and insurance associated with the moving of a relocatable classroom building?

_____
_____
_____
_____
_____
_____

41. When required, what are the costs of professional consulting fees for installation of your relocatable classroom units:

a. Architectural _____
b. Civil Engineering _____
c. Structural _____
d. Mechanical _____
e. Electrical _____

42. Does your district UBCI (Uniform Building Code Inspector) inspect the installation of all relocatable classrooms in your district?

Yes_____ No_____

If no, then why not?

_____
_____
_____
_____
_____
_____
_____

43. Please provide the following information pertaining to the **detachment** of relocatable classroom buildings in your district.

a. $_____ Cost of disconnecting electrical power?

Who performs this work?

_____

_____

b. $_____ Cost of disconnecting gas service?

Who performs this work?

_____

_____

c. $_____ Cost of disconnecting sewer and water service?

Who performs this work?

_____

_____

d. $_____ Cost of structural detachment?

Who performs this work?

_____

_____

e. Are the existing pier foundations reused or destroyed? Why?

_____

_____

_____

_____

f. $_____ Cost of clearing the area for transportation?

Who performs this work?

_____

_____

g. $_____ Cost of redeveloping (reclaiming) the site once the relocatable units are gone. i.e. landscaping, cleaning?

Who performs this work?

_____

_____

44. Does your district have a maintenance staff dedicated solely to relocatable classrooms? If yes, what is their yearly budget for repairs and maintenance?

Yes_____ No_____

_____
_____
_____
_____
_____

45. Please provide the following information and the cost associated with each operating pertaining to the ongoing <u>maintenance</u> of your relocatable classroom units.

a. $_____ Cost of keeping the units clean (housekeeping)?

b. $_____ Cost of repairs to the structural and support systems?

c. $_____ Cost of repairs to the exterior finishes?

d. $_____ Cost of repairs to the interior finishes?

e. $_____ Cost of repairs to the electrical systems?

f. $_____ Cost of repairs to the mechanical systems?

g. $_____ Cost of repairs to the plumbing systems?

h. $_____ Cost of repairs to the roofing systems?

46. How do these repair costs compare to your permanent classroom buildings?

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

47. What are the utility costs associated with operating a relocatable classroom building in your district?

a. Electrical -

$_____ Lighting and operating school equipment?

$_____ Operating heating & cooling equipment?

b. $_____ Mechanical - Gas?

c. Plumbing -

$_____ Sewage charges?

$_____ Water usage charges?

48. How has your relocatable classroom buildings endured severe weather conditions such as tornadoes, hail storms, heavy rain, and hurricanes?

_____
_____
_____
_____

49. What is the severity of damage that has occurred?

_____
_____
_____
_____
_____
_____
_____
_____

50. How does the damage that occurred to your relocatable classrooms compare to your permanent classroom buildings?

_____
_____
_____
_____
_____
_____
_____
_____
_____

51. What was the cost of repairing your relocatable classroom buildings that occurred from intense weather conditions?

52. In your school district, has there every been loss of life, injury, or severe damage as a result of a fire in a relocatable classroom building? If yes, please explain.

Yes_____ No_____

53. In your school district, has there been loss of life or severe injury to a student, faculty or staff member, or visitor that can be directly associated with a relocatable classroom? If yes, please explain.

Yes_____ No_____

54. How do you dispose of a relocatable classroom building when it is no longer of use to your school district?

55. Where do you store extra (surplus) relocatable classroom buildings?

_____
_____
_____
_____
_____

56. What are the costs involved with the storage of these extra (surplus) relocatable units?

_____
_____
_____
_____
_____
_____

57. How do you presently mark or identify each relocatable in your district for inventory/tracking purposes?

_____
_____
_____
_____

58. What fund source(s) has been used by your district to pay for the purchase, construction or lease of relocatable classrooms?

	Build	Lease	Buy
PECO/Unit Allocation 235.435(3) F.S.	_____	_____	_____
CO & DS	_____	_____	_____
SBE Bond (COBI)	_____	_____	_____
237.162, F.S. Loan	_____	_____	_____
Local Bonds	_____	_____	_____
L.C.I.F.	_____	_____	_____
Local Discretionary Millage 236.25(2) F.S.	_____	_____	_____
235.056(3)(a), F.S. Lease Purchase (COP)	_____	_____	_____
Federal	_____	_____	_____
Other Local (specify)_____	_____	_____	_____

Appendix B

FLORIDA DEPARTMENT OF EDUCATION
OFFICE OF EDUCATION FACILITIES

Relocatable Classroom Survey for Teachers

Instructions for completing the survey:

The Florida Center for Community Design + Research, located at the University of South Florida, has been selected by the Florida Department of Education, Office of Educational Facilities, to conduct a study to evaluate the use of relocatable classrooms in the sixty-seven Florida school districts.

Your response to this survey is of great importance in order for the staff of the Center to analyze and report to the Department of Education the present use of relocatable classrooms.

Please respond directly on the survey form (both sides of page). Make your responses heavy and dark, using a number 2 pencil. If you do not have an informed opinion about an item or you consider it inapplicable to your situation, please mark the "Don't know/not applicable" space at the far right.

After completing the survey form, return it to the Principal or other designated person for transmittal to the Florida Center for Community Design and Research, 3702 Spectrum Boulevard, Suite 180, Tampa, FL 33612, (813) 974-4042, Attention: Steve Cooke, Principal Investigator, **PRIOR TO JUNE 4, 1993**. **Do Not Fold the Survey Form**; folding will complicate the scoring.

District Name: _____

School Name: _____

1. Grade level you presently teach for the majority of the day.

- Pre-Kindergarten or Kindergarten
- 1st, 2nd or 3rd Grade
- 4th, 5th or 6th Grade
- 7th, 8th or 9th Grade
- 10th, 11th, or 12th Grade
- Exceptional Education
- Adult Education
- Other

2. Number of years teaching experience: 0-5 5-10 11-15 16-20 21+

3. How many years have you taught in a relocatable (portable)? 0-1 2 3-5 6+

4. What is the type of relocatable (portable) you are now using?

- 0 Narrow (12 ft. wide by 60 ft. long)
- 1 Standard (24 ft. wide by 32 ft. to 40 ft. long)
- 2 Long (24 ft. wide by 60 ft. long)

5. To the best of your knowledge how old is the relocatable you are now using?

new (1 - 3 yrs) fairly new (3 - 5 yrs) fairly old (5 - 15 yrs) old (> 15 yrs)

6. During the course of the day what is the maximum number of students that use your relocatable at one time?

10 or less 11-20 21-30 more than 30

"SEE OPPOSITE SIDE"

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	Strongly agree	moderately agree	moderately disagree	strongly disagree	don't know/not applicable
7. The design of the relocatable allows me to arrange my classroom in ways that encourage optimum learning.					
8. The physical layout of the relocatable allows me to use new teaching technologies, e.g., computers, audio-visual equipment.					
9. There are adequate storage areas in my relocatable.					
10. The height of the ceiling is adequate.					
11. There is adequate lighting for reading and other demanding visual tests.					
12. Overall lighting conditions lend to a pleasant learning environment.					
13. The absence (or limited amount) of windows in the relocatable creates an atmosphere that is not conducive for efficient and effective learning.					
14. Adequate air movement can be obtained when needed.					
15. There is an adequate supply of fresh air.					
16. Comfortable air temperatures can be maintained.					
17. Noise created by the air conditioning/heating system does not interfere with effective communication and learning.					
18. Outside noise is more of a problem in the relocatable that in a permanent classroom.					
19. Acoustics in the relocatable are suitable for the task and activities that take place.					
20. Plumbing facilities (sinks, toilets) for the class(s) are adequate.					
21. Odor from toilet areas has not been a problem.					
22. There are adequate electrical outlets for use of equipment needed for teaching.					
23. I must be more concerned with safety issues in my relocatable than in a permanent classroom.					
24. Vandalism is more of a problem in relocatables than in permanent classrooms.					
25. I feel just as secure in my relocatable as I do in a permanent classroom.					
26. During inclement weather I feel secure in my portable.					
27. The current physical condition of the building (relocatable) that I am using creates an uncomfortable setting for teaching.					
28. The overall visual appearance (aesthetics) of the portable creates a level of discomfort that becomes a factor in my attitude toward teaching.					
29. The materials for the walls, floor and ceilings create a comfortable environment for learning.					
30. Teaching in a relocatable classroom creates feelings of inequality with other teachers that have permanent classrooms.					
31. Teaching in a relocatable creates a negative feeling of isolation from the other teachers in the school.					
32. Teaching in a relocatable hinders positive interaction with other instructors and administrators.					
33. Walkways leading to my relocatable are adequately covered.					
34. The location of my relocatable in relationship to other facilities in the school has created problems.					
35. My teaching style had to change when I began teaching in a relocatable.					
36. I have had to modify the curriculum in response to teaching in the relocatable classroom.					
37. I encounter less discipline management problems in my relocatable than in a permanent classroom.					
38. My students prefer the portable classroom over permanent classrooms.					
39. Parents of my students do not object to their children being taught in a relocatable.					
40. My relocatable is accessible to and usable by persons with disabilities.					

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Appendix C

EXISTING FACILITY STUDY

County Name:..... **School Name:**.....

Contact Name:..... **Phone #:**.....

SAFETY

Unit No.....of.....

FIRE CODE:

Minimum Distance between relocatables?.....Ft.

What is the distance between the closest relocatable and the rest of the school core?

.....Ft.

What is the distance between the portables being surveyed and the school core?.....Ft.

Are the walkways to relocatables in good condition free of cracks, settlements, and uplifts?

..... ☐ Yes ☐ No

Are the stairs properly attached to the unit? ☐ Yes ☐ No

Do steps have adequate treads and risers (max. riser 7"; max. tread 11") ☐ Yes ☐ No

Does the unit have a skirt around it? ☐ Yes ☐ No

Is the crawl space free of debris? ☐ Yes ☐ No

Is the towing frame (if applicable) stored safely? ☐ Yes ☐ No

ACCESSIBILITY (American Disabilities Act)

Egress: Are there **Two** means of egress? ☐ Yes ☐ No

Accessibility: Are the passageways accessible to persons with disabilities? ☐ Yes ☐ No

Safe stairs: Are risers heights and tread widths uniform? ☐ Yes ☐ No

Are risers open? ☐ Yes ☐ No

Are hand rails on both sides of the stairs? ☐ Yes ☐ No

BUILDING INTEGRITY (CONDITION OF BUILDING)

AGE OF BUILDING AND ASPECTS OF DETERIORATION

.....

.....

.....

.....

EXTERIOR APPEARENCE:

FOUNDATION

- ☐ Steel Pier on Pad
- ☐ Precast Pier on Pad
- ☐ CMU Pier on pad
- ☐ Slab on Grade
- ☐ Continuous Footing
- ☐ Other

Comments:.....

.....

Is the building adequately maintained? ☐ Yes ☐ No

TIE DOWNS ☐ Yes ☐ No

Are tie downs all secure? ☐ Yes ☐ No

Condition:.....

.....

FLOOR STRUCTURE ☐ Steel ☐Wood ☐ Combined

Condition:.....

.....

EXTERIOR FINISHES ☐Wood ☐ Aluminum/Metal ☐ CMU ☐Stucco

Condition:.....

.....

ROOFING ☐ Shingles ☐ Aluminum ☐ Single Ply ☐ Other

Condition:.....

.....

CRAWL SPACE ☐Yes ☐ No

Condition:.....

.....

BURMING ☐Yes ☐ No

Condition:.....

.....

Ramps: Are there existing ramps (ramp slope = 1:12) ? ☐ Yes ☐ No

Are there adequate fire extinguishers? ☐ Yes ☐ No

Are there adequate visual and audible fire alarms? ☐ Yes ☐ No

SITE PLACEMENT ISSUES AFTER PORTABLE REMOVAL

IMPACT ON SITE

Are all traces of moved portables gone from previous location? ☐ Yes ☐ No

If not, check appropriate boxes below

☐ Sidewalks

☐ Utilities

☐ Left over footings

☐ Other traces of the presence of relocatables

AESTHETIC ISSUES

APPEARANCE OF PORTABLE

IMPACT ON OVERALL SCHOOL APPEARANCE AND COMMUNITY

Is the school core comparable in aesthetics and quality with the community? ☐ Yes ☐ No

Are the portables comparable in aesthetics and quality with the school core? ☐ Yes ☐ No

Comment on the aesthetics and quality of community buildings, school core and portables:.....

.....

Were the locations of the portables planned? ☐ Yes ☐ No

a. Does the school have random pouring of concrete sidewalks? ☐ Yes ☐ No

b. Does the school lack landscaping elements? ☐ Yes ☐ No

c. Do the portables lack landscaping elements? ☐ Yes ☐ No

c. Are utility lines visually obstructing? ☐ Yes ☐ No

SAGGING DOORS AND WINDOWS ☐ Yes ☐ No

Condition:.....

.....

DOORS (AIR LEAKS) ☐ Yes ☐ No

Are the doors operable ☐ Yes ☐ No

Are the door widths in conformance with Life Safety requirements? ☐ Yes ☐ No

Are any of the doors obstructed by furniture or other equipment? ☐ Yes ☐ No

WINDOWS

Are there windows? ☐ Yes ☐ No

Are there air leaks? ☐ Yes ☐ No

Are windows operable? ☐ Yes ☐ No

FLOORING

☐ Wood ☐ Carpet ☐ Concrete ☐ Vinyl ☐ Other

Is floor surface stable, firm, and slip resistant? ☐ Yes ☐ No

Is flooring material securely attached? ☐ Yes ☐ No

Do joint plates between sections lay flat against floor? ☐ Yes ☐ No

INTERIOR WALLS ☐ CMU ☐ Paneling ☐ Paint/drywall ☐Vinyl wallcovering

☐Other

Condition.....

.....

WALL COLOR ☐ Light ☐ Medium ☐ Dark

CEILING HEIGHT .....(In Feet and Inches)

CEILING COLOR ☐ Light ☐ Medium ☐ Dark

Are ceiling tiles clean, devoid of stains, sags, and missing pieces? ☐ Yes ☐ No

FUNCTIONAL COMPLIANCE

ROOM LAYOUT:

Unit Size.....Ft.

☐ Square ☐ Rectangle

Is the storage area adequate? ☐ Yes ☐ No

PLUMBING:

Is there a bathroom in unit? ☐ Yes ☐ No

Does the toilet room comply with ADA? ☐ Yes ☐ No

Is there sufficient ventilation in the toilet room? ☐ Yes ☐ No

ELECTRICAL

Are there sufficient electrical outlets? (every 6ft.) ☐ Yes ☐ No

Are electrical outlets a minimum of 15" and a maximum of 44" from the center of outlet to the floor? ☐ Yes ☐ No

QUALITY OF PHYSICAL ENVIRONMENT

What is the foot candle level per light meter?.....

Measure from:

Desk.....

Floor.....

Chalk board.....

NATURAL LIGHT:

Please estimate the the number of windows and the window area.

Quantity	Size	Area
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....

Total Area.....

SOUND: What is the decibel level per noise meter when the AC is ON?.....

HEARING: Are there any audible problems such as echos or speech comprehension? ☐ Yes ☐ No

NOISE: Are there any background or ouside noises that are not tolerable? ☐ Yes ☐ No

AIR QUALITY:

Is there enough fresh air intake? ☐ Yes ☐ No

Can you perceive any disturbing odors: mildew, old carpeting material, toilet...? ☐ Yes ☐ No

Comment.....

QUESTIONS TO TEACHERS

Do you have disciplinary problems? ☐ Yes ☐ No

Is the portable in reasonable proximity to existing building? ☐ Yes ☐ No

What is the average number of students per portable? .....

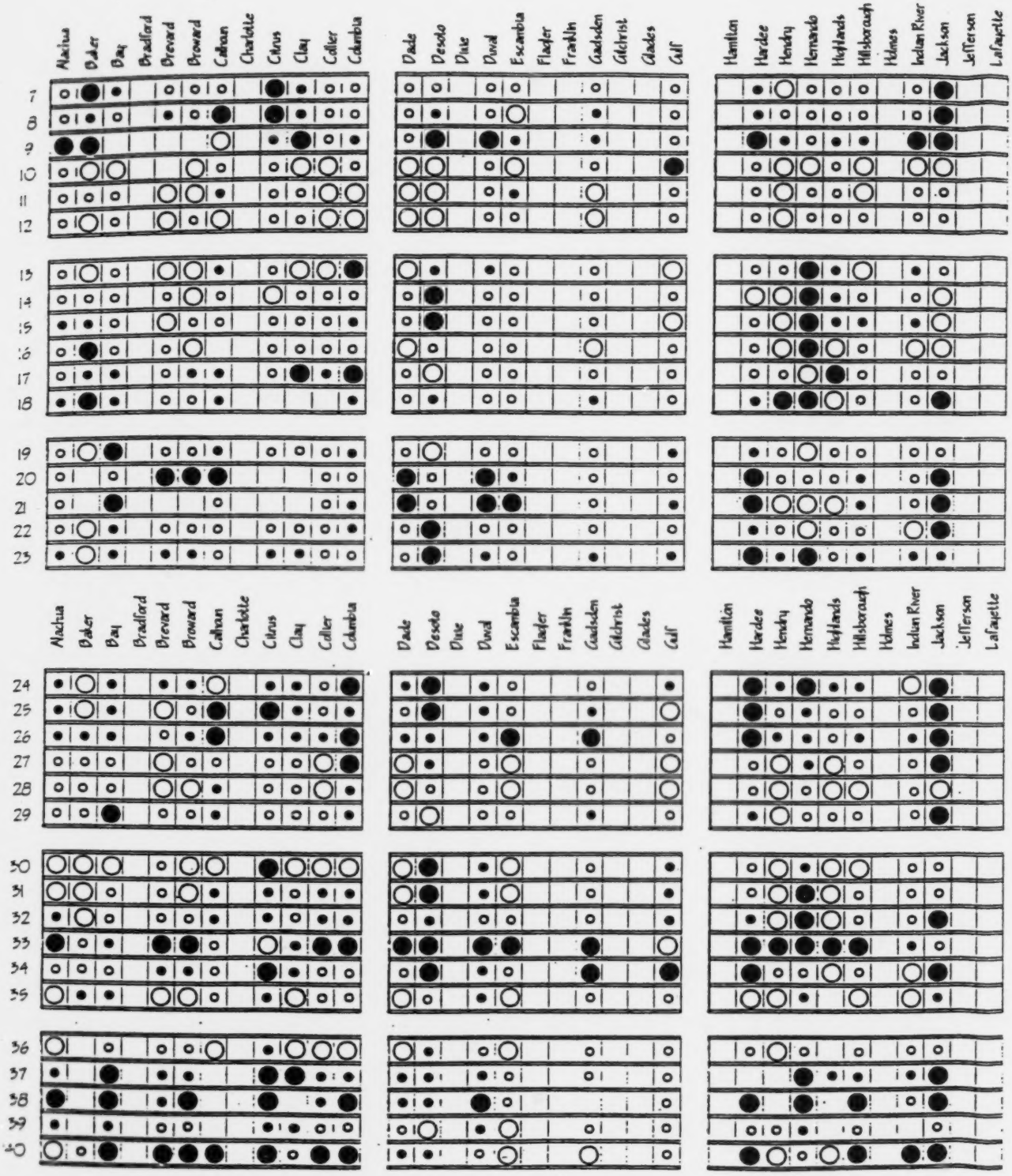
Is the room temperature comfortable? ☐ Yes ☐ No

How would you improve the design of the portable?.....

.....

.....

Appendix D



MATRIX REPRESENTING THE TEACHER'S EVALUATION ON THE RELOCATABLE CLASSROOMS BY COUNTY - Alachua through Lafayette

Legend: o Strongly Agree · Moderately Disagree
° Moderately Agree • Strongly Disagree

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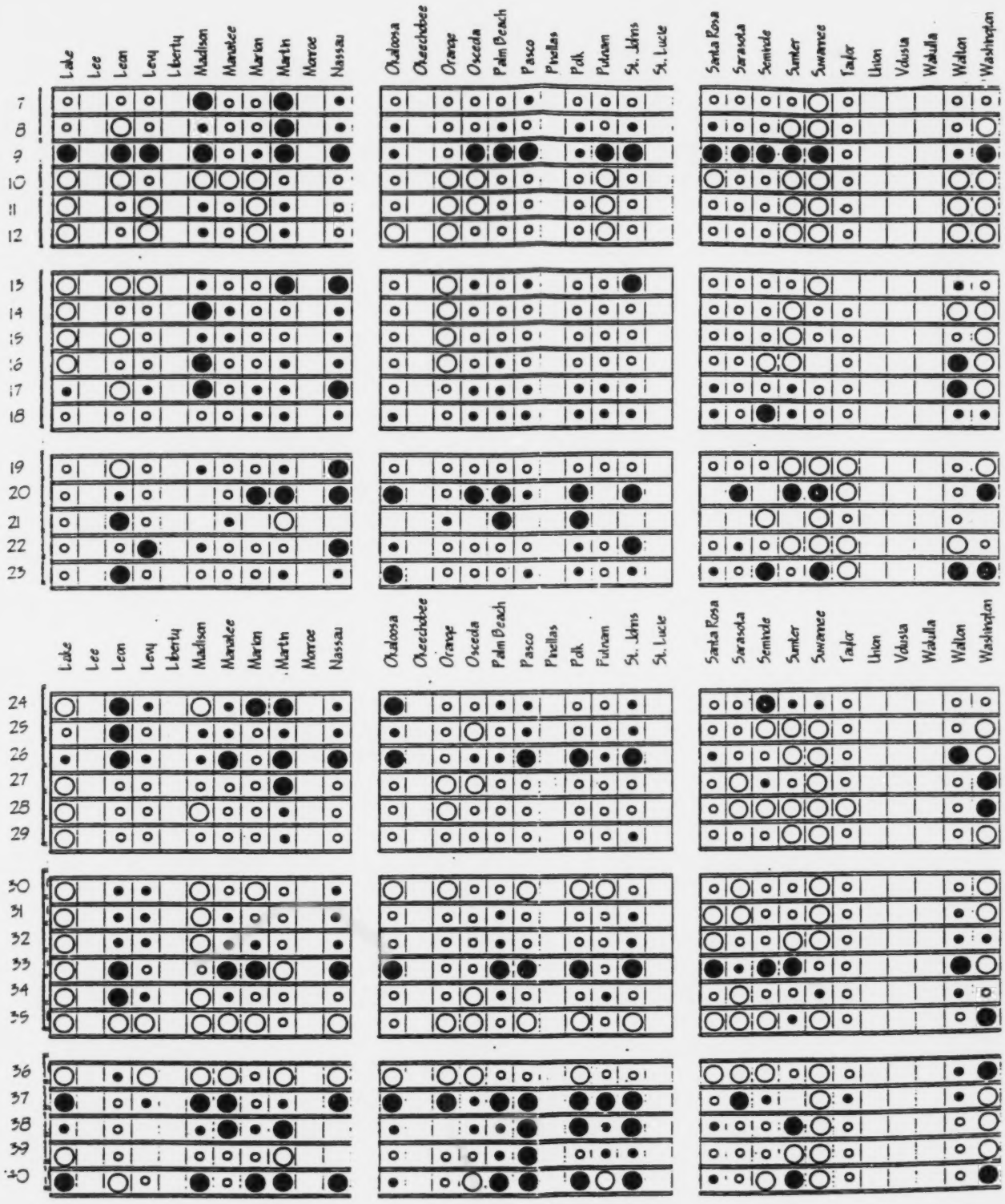
Lake Lee Lean Levy Liberty Madison Manatee Marion Martin Monroe Nassau
Okaloosa Okeechobee Orange Osceola Palm Beach Pasco Pinellas Polk Putnam St. Johns St. Lucie
Santa Rosa Sarasota Seminole Sumter Suwannee Taylor Union Volusia Wakulla Walton Washington
1 2 3 4 5 6 7 8 9 10 11 12
13 14 15 16 17 18
19 20 21 22 23
24 25 26 27 28 29
30 31 32 33 34 35
36 37 38 39 40

MATRIX REPRESENTING THE TEACHER'S EVALUATION ON THE RELOCATABLE CLASSROOMS BY COUNTY - Lake through Washington

Legend: o Strongly Agree · Moderately Disagree
° Moderately Agree • Strongly Disagree

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Appendix E

Life Cycle Cost Analysis

Low-End Relocatable
Assumptions:
12 Kwh Useage Per Sq. Ft. Annually
$2.75 Maintenence Cost Per Sq. Ft. Annually
Service Life of 30 Years
Cost of Capital 6.00%

Annual Inflation Rate	Breakeven Price Per Sq. Ft.	Total NPV Life Cycle Cost
3.75%	$17	$115,800

Low-End Relocatable
Assumptions:
10 Kwh Useage Per Sq. Ft. Annually
$2.30 Maintenence Cost Per Sq. Ft. Annually
Service Life of 30 Years
Cost of Capital 6.00%

Annual Inflation Rate	Breakeven Price Per Sq. Ft.	Total NPV Life Cycle Cost
3.75%	$31	$115,800

Mid- and Upper Range Relocatable
Assumptions:
11 Kwh Useage Per Sq. Ft. Annually
$2.50 Maintenence Cost Per Sq. Ft. Annually
Service Life of 35 Years
Cost of Capital 6.00%

Annual Inflation Rate	Breakeven Price Per Sq. Ft.	Total NPV Life Cycle Cost
3.75%	$29	$115,800

Mid- and Upper Range Relocatable
Assumptions:
10 Kwh Useage Per Sq. Ft. Annually
$2.30 Maintenence Cost Per Sq. Ft. Annually
Service Life of 35 Years
Cost of Capital 6.00%

Annual Inflation Rate	Breakeven Price Per Sq. Ft.	Total NPV Life Cycle Cost
3.75%	$37	$115,800

Life Cycle Cost Analysis

Low-End Relocatable
Assumptions:
12 Kwh Useage Per Sq. Ft. Annually
$2.75 Maintenence Cost Per Sq. Ft. Annually
Service Life of 30 Years
Cost of Capital 6.50%

Annual Inflation Rate	Breakeven Price Per Sq. Ft.	Total NPV Life Cycle Cost
3.75%	$18	$110,500

Low-End Relocatable
Assumptions:
10 Kwh Useage Per Sq. Ft. Annually
$2.30 Maintenence Cost Per Sq. Ft. Annually
Service Life of 30 Years
Cost of Capital 6.50%

Annual Inflation Rate	Breakeven Price Per Sq. Ft.	Total NPV Life Cycle Cost
3.75%	$31	$110,500

Mid- and Upper Range Relocatable
Assumptions:
11 Kwh Useage Per Sq. Ft. Annually
$2.50 Maintenence Cost Per Sq. Ft. Annually
Service Life of 35 Years
Cost of Capital 6.50%

Annual Inflation Rate	Breakeven Price Per Sq. Ft.	Total NPV Life Cycle Cost
3.75%	$29	$110,500

Mid- and Upper Range Relocatable
Assumptions:
10 Kwh Useage Per Sq. Ft. Annually
$2.30 Maintenence Cost Per Sq. Ft. Annually
Service Life of 35 Years
Cost of Capital 6.50%

Annual Inflation Rate	Breakeven Price Per Sq. Ft.	Total NPV Life Cycle Cost
3.75%	$37	$110,500

Life Cycle Cost Analysis

Low-End Relocatable
Assumptions:
12 Kwh Useage Per Sq. Ft. Annually
$2.75 Maintenence Cost Per Sq. Ft. Annually
Service Life of 30 Years
Cost of Capital 7.00%

Annual Inflation Rate	Breakeven Price Per Sq. Ft.	Total NPV Life Cycle Cost
3.75%	$19	$105,800

Low-End Relocatable
Assumptions:
10 Kwh Useage Per Sq. Ft. Annually
$2.30 Maintenence Cost Per Sq. Ft. Annually
Service Life of 30 Years
Cost of Capital 7.00%

Annual Inflation Rate	Breakeven Price Per Sq. Ft.	Total NPV Life Cycle Cost
3.75%	$32	$105,800

Mid- and Upper Range Relocatable
Assumptions:
11 Kwh Useage Per Sq. Ft. Annually
$2.50 Maintenence Cost Per Sq. Ft. Annually
Service Life of 35 Years
Cost of Capital 7.00%

Annual Inflation Rate	Breakeven Price Per Sq. Ft.	Total NPV Life Cycle Cost
3.75%	$30	$105,800

Mid- and Upper Range Relocatable
Assumptions:
10 Kwh Useage Per Sq. Ft. Annually
$2.30 Maintenence Cost Per Sq. Ft. Annually
Service Life of 35 Years
Cost of Capital 7.00%

Annual Inflation Rate	Breakeven Price Per Sq. Ft.	Total NPV Life Cycle Cost
3.75%	$37	$105,800

F.D.O.E. Life Cycle Cost Analysis

Net Present Value	
Permanent	($115,833)
Relocatable	($115,645)

Low End Relocatable (Assume Operation & Maintenance Cost Equivalent to Permanent Addition)

Annual Interest Payments	
Cost of Capital (Muni Rate)	6.00%
Inflation Rate	3.75%
Discount Rate	2.25%
Initial Capital Outlay	
Size (Sq. Ft.)	
Permanent	1,000
Relocatable	1,000
Structure Life (Years)	
Permanent	50
Relocatable	30
E.O.L. Value	
Permanent	40.00%
Relocatable	0.00%
Const. Cost (Sq. Ft.)	
Permanent	$61
Relocatable	$31
Lease	$0.0
Total Const. Cost	
Permanent	$61,000
Relocatable	$31,000
Lease	$0

Recurring Costs	
Annual Operating Cost	
KWH Permanent Sq. Ft.	10
KWH Relocatable Sq. Ft.	10
KWH Cost	$0.10
Permanent	$1,000
Relocatable	$1,000
Annual Maintenance Cost	
Permanent Sq. Ft.	$2.30
Relocatable Sq. Ft.	$2.30
Permanent	$2,300
Relocatable	$2,300
Replacement Costs HVAC Life (Years)	
Permanent	23
Relocatable	15
HVAC Cost	
Permanent	$1,667
Relocatable	$2,775
Roof Life (Years)	
Permanent	15
Relocatable	15
Roof Cost	
Permanent	$5,500
Relocatable	$3,500
Refurbishment	
Permanent 15 Yr.	$4,000
Relocatable 15 Yr.	$9,000
Relocatable Specific Costs	
Moving	$2,068
Connecting	$2,275
Detachment	$600
Avg. Annual Moves	0
Total Moving Costs	$0

F.D.O.E. Life Cycle Cost Analysis

Net Present Value	
Permanent	($110,640)
Relocatable	($110,266)

Annual Interest Payments	
Cost of Capital (Muni Rate)	6.50%
Inflation Rate	3.75%
Discount Rate	2.75%
Initial Capital Outlay	
Size (Sq. Ft.)	
Permanent	1,000
Relocatable	1,000
Structure Life (Years)	
Permanent	50
Relocatable	30
E.O.L. Value	
Permanent	40.00%
Relocatable	0.00%
Const. Cost (Sq. Ft.)	
Permanent	$61
Relocatable	$31
Lease	$0.0
Total Const. Cost	
Permanent	$61,000
Relocatable	$31,000
Lease	$0

Recurring Costs	
Annual Operating Cost	
KWH Permanent Sq. Ft.	10
KWH Relocatable Sq. Ft.	10
KWH Cost	$0.10
Permanent	$1,000
Relocatable	$1,000
Annual Maintenance Cost	
Permanent Sq. Ft.	$2.30
Relocatable Sq. Ft.	$2.30
Permanent	$2,300
Relocatable	$2,300
Replacement Costs HVAC Life (Years)	
Permanent	23
Relocatable	15
HVAC Cost	
Permanent	$1,667
Relocatable	$2,775
Roof Life (Years)	
Permanent	15
Relocatable	15
Roof Cost	
Permanent	$5,500
Relocatable	$3,500
Refurbishment	
Permanent 15 Yr.	$4,000
Relocatable 15 Yr.	$9,000
Relocatable Specific Costs	
Moving	$2,068
Connecting	$2,275
Detachment	$600
Avg. Annual Moves	0
Total Moving Costs	$0

F.D.O.E. Life Cycle Cost Analysis

Net Present Value	
Permanent	($105,919)
Relocatable	($105,870)

Annual Interest Payments	
Cost of Capital (Muni Rate)	7.00%
Inflation Rate	3.75%
Discount Rate	3.25%
Initial Capital Outlay	
Size (Sq. Ft.)	
Permanent	1,000
Relocatable	1,000
Structure Life (Years)	
Permanent	50
Relocatable	30
E.O.L. Value	
Permanent	40.00%
Relocatable	0.00%
Const. Cost (Sq. Ft.)	
Permanent	$61
Relocatable	$32
Lease	$0.0
Total Const. Cost	
Permanent	$61,000
Relocatable	$31,500
Lease	$0

Recurring Costs	
Annual Operating Cost	
KWH Permanent Sq. Ft.	10
KWH Relocatable Sq. Ft.	10
KWH Cost	$0.10
Permanent	$1,000
Relocatable	$1,000
Annual Maintenance Cost	
Permanent Sq. Ft.	$2.30
Relocatable Sq. Ft.	$2.30
Permanent	$2,300
Relocatable	$2,300
Replacement Costs	
HVAC Life (Years)	
Permanent	23
Relocatable	15
HVAC Cost	
Permanent	$1,667
Relocatable	$2,775
Roof Life (Years)	
Permanent	15
Relocatable	15
Roof Cost	
Permanent	$5,500
Relocatable	$3,500
Refurbishment	
Permanent 15 Yr.	$4,000
Relocatable 15 Yr.	$9,000
Relocatable Specific Costs	
Moving	$2,068
Connecting	$2,275
Detachment	$600
Avg. Annual Moves	0
Total Moving Costs	$0

F.D.O.E. Life Cycle Cost Analysis

Net Present Value	
Permanent	($115,833)
Relocatable	($115,714)

Low End Relocatable (Assume Low End Operation and Maintenance Costs)

Annual Interest Payments	
Cost of Capital (Muni Rate)	6.00%
Inflation Rate	3.75%
Discount Rate	2.25%
Initial Capital Outlay	
Size (Sq. Ft.)	
Permanent	1,000
Relocatable	1,000
Structure Life (Years)	
Permanent	50
Relocatable	30
E.O.L. Value	
Permanent	40.00%
Relocatable	0.00%
Const. Cost (Sq. Ft.)	
Permanent	$61
Relocatable	$17
Lease	$0.0
Total Const. Cost	
Permanent	$61,000
Relocatable	$17,000
Lease	$0

Recurring Costs	
Annual Operating Cost	
KWH Permanent Sq. Ft.	10
KWH Relocatable Sq. Ft.	12
KWH Cost	$0.10
Permanent	$1,000
Relocatable	$1,200
Annual Maintenance Cost	
Permanent Sq. Ft.	$2.30
Relocatable Sq. Ft.	$2.75
Permanent	$2,300
Relocatable	$2,750
Replacement Costs HVAC Life (Years)	
Permanent	23
Relocatable	15
HVAC Cost	
Permanent	$1,667
Relocatable	$2,775
Roof Life (Years)	
Permanent	15
Relocatable	15
Roof Cost	
Permanent	$5,500
Relocatable	$3,500
Refurbishment	
Permanent 15 Yr.	$4,000
Relocatable 15 Yr.	$9,000
Relocatable Specific Costs	
Moving	$2,068
Connecting	$2,275
Detachment	$600
Avg. Annual Moves	0
Total Moving Costs	$0

F.D.O.E. Life Cycle Cost Analysis

Net Present Value	
Permanent	($110,640)
Relocatable	($110,428)

Annual Interest Payments	
Cost of Capital (Muni Rate)	6.50%
Inflation Rate	3.75%
Discount Rate	2.75%
Initial Capital Outlay	
Size (Sq. Ft.)	
Permanent	1,000
Relocatable	1,000
Structure Life (Years)	
Permanent	50
Relocatable	30
E.O.L. Value	
Permanent	40.00%
Relocatable	0.00%
Const. Cost (Sq. Ft.)	
Permanent	$61
Relocatable	$18
Lease	$0.0
Total Const. Cost	
Permanent	$61,000
Relocatable	$18,000
Lease	$0

Recurring Costs	
Annual Operating Cost	
KWH Permanent Sq. Ft.	10
KWH Relocatable Sq. Ft.	12
KWH Cost	$0.10
Permanent	$1,000
Relocatable	$1,200
Annual Maintenance Cost	
Permanent Sq. Ft.	$2.30
Relocatable Sq. Ft.	$2.75
Permanent	$2,300
Relocatable	$2,750
Replacement Costs	
HVAC Life (Years)	
Permanent	23
Relocatable	15
HVAC Cost	
Permanent	$1,667
Relocatable	$2,775
Roof Life (Years)	
Permanent	15
Relocatable	15
Roof Cost	
Permanent	$5,500
Relocatable	$3,500
Refurbishment	
Permanent 15 Yr.	$4,000
Relocatable 15 Yr.	$9,000
Relocatable Specific Costs	
Moving	$2,068
Connecting	$2,275
Detachment	$600
Avg. Annual Moves	0
Total Moving Costs	$0

F.D.O.E. Life Cycle Cost Analysis

Net Present Value	
Permanent	($105,919)
Relocatable	($105,708)

Annual Interest Payments	
Cost of Capital (Muni Rate)	7.00%
Inflation Rate	3.75%
Discount Rate	3.25%
Initial Capital Outlay	
Size (Sq. Ft.)	
Permanent	1,000
Relocatable	1,000
Structure Life (Years)	
Permanent	50
Relocatable	30
E.O.L. Value	
Permanent	40.00%
Relocatable	0.00%
Const. Cost (Sq. Ft.)	
Permanent	$61
Relocatable	$19
Lease	$0.0
Total Const. Cost	
Permanent	$61,000
Relocatable	$19,000
Lease	$0

Recurring Costs	
Annual Operating Cost	
KWH Permanent Sq. Ft.	10
KWH Relocatable Sq. Ft.	12
KWH Cost	$0.10
Permanent	$1,000
Relocatable	$1,200
Annual Maintenance Cost	
Permanent Sq. Ft.	$2.30
Relocatable Sq. Ft.	$2.75
Permanent	$2,300
Relocatable	$2,750
Replacement Costs HVAC Life (Years)	
Permanent	23
Relocatable	15
HVAC Cost	
Permanent	$1,667
Relocatable	$2,775
Roof Life (Years)	
Permanent	15
Relocatable	15
Roof Cost	
Permanent	$5,500
Relocatable	$3,500
Refurbishment	
Permanent 15 Yr.	$4,000
Relocatable 15 Yr.	$9,000
Relocatable Specific Costs	
Moving	$2,068
Connecting	$2,275
Detachment	$600
Avg. Annual Moves	0
Total Moving Costs	$0

F.D.O.E. Life Cycle Cost Analysis

Net Present Value	
Permanent	($115,833)
Relocatable	($115,931)

Mid & Upper End Relocatable (Assume Operation & Maintenance Cost Equivalent to Permanent Addition)

Annual Interest Payments	
Cost of Capital (Muni Rate)	6.00%
Inflation Rate	3.75%
Discount Rate	2.25%
Initial Capital Outlay	
Size (Sq. Ft.)	
Permanent	1,000
Relocatable	1,000
Structure Life (Years)	
Permanent	50
Relocatable	35
E.O.L. Value	
Permanent	40.00%
Relocatable	14.29%
Const. Cost (Sq. Ft.)	
Permanent	$61
Relocatable	$37
Lease	$0.0
Total Const. Cost	
Permanent	$61,000
Relocatable	$36,500
Lease	$0

Recurring Costs	
Annual Operating Cost	
KWH Permanent Sq. Ft.	10
KWH Relocatable Sq. Ft.	10
KWH Cost	$0.10
Permanent	$1,000
Relocatable	$1,000
Annual Maintenance Cost	
Permanent Sq. Ft.	$2.30
Relocatable Sq. Ft.	$2.30
Permanent	$2,300
Relocatable	$2,300
Replacement Costs HVAC Life (Years)	
Permanent	23
Relocatable	15
HVAC Cost	
Permanent	$1,667
Relocatable	$2,775
Roof Life (Years)	
Permanent	15
Relocatable	15
Roof Cost	
Permanent	$5,500
Relocatable	$3,500
Refurbishment	
Permanent 15 Yr.	$4,000
Relocatable 15 Yr.	$9,000
Relocatable Specific Costs	
Moving	$2,068
Connecting	$2,275
Detachment	$600
Avg. Annual Moves	0
Total Moving Costs	$0

F.D.O.E. Life Cycle Cost Analysis

Net Present Value	
Permanent	($110,640)
Relocatable	($110,552)

Annual Interest Payments	
Cost of Capital (Muni Rate)	6.50%
Inflation Rate	3.75%
Discount Rate	2.75%
Initial Capital Outlay	
Size (Sq. Ft.)	
Permanent	1,000
Relocatable	1,000
Structure Life (Years)	
Permanent	50
Relocatable	35
E.O.L. Value	
Permanent	40.00%
Relocatable	14.29%
Const. Cost (Sq. Ft.)	
Permanent	$61
Relocatable	$37
Lease	$0.0
Total Const. Cost	
Permanent	$61,000
Relocatable	$36,500
Lease	$0

Recurring Costs	
Annual Operating Cost	
KWH Permanent Sq. Ft.	10
KWH Relocatable Sq. Ft.	10
KWH Cost	$0.10
Permanent	$1,000
Relocatable	$1,000
Annual Maintenance Cost	
Permanent Sq. Ft.	$2.30
Relocatable Sq. Ft.	$2.30
Permanent	$2,300
Relocatable	$2,300
Replacement Costs	
HVAC Life (Years)	
Permanent	23
Relocatable	15
HVAC Cost	
Permanent	$1,667
Relocatable	$2,775
Roof Life (Years)	
Permanent	15
Relocatable	15
Roof Cost	
Permanent	$5,500
Relocatable	$3,500
Refurbishment	
Permanent 15 Yr.	$4,000
Relocatable 15 Yr.	$9,000
Relocatable Specific Costs	
Moving	$2,068
Connecting	$2,275
Detachment	$600
Avg. Annual Moves	0
Total Moving Costs	$0

F.D.O.E. Life Cycle Cost Analysis

Net Present Value	
Permanent	($115,833)
Relocatable	($115,996)

Mid & Upper End Relocatable (Assume Operation & Maintenance Costs of Mid Upper End Unit)

Annual Interest Payments	
Cost of Capital (Muni Rate)	6.00%
Inflation Rate	3.75%
Discount Rate	2.25%
Initial Capital Outlay	
Size (Sq. Ft.)	
Permanent	1,000
Relocatable	1,000
Structure Life (Years)	
Permanent	50
Relocatable	35
E.O.L. Value	
Permanent	40.00%
Relocatable	14.29%
Const. Cost (Sq. Ft.)	
Permanent	$61
Relocatable	$29
Lease	$0.0
Total Const. Cost	
Permanent	$61,000
Relocatable	$29,000
Lease	$0

Recurring Costs	
Annual Operating Cost	
KWH Permanent Sq. Ft.	10
KWH Relocatable Sq. Ft.	11
KWH Cost	$0.10
Permanent	$1,000
Relocatable	$1,100
Annual Maintenance Cost	
Permanent Sq. Ft.	$2.30
Relocatable Sq. Ft.	$2.50
Permanent	$2,300
Relocatable	$2,500
Replacement Costs	
HVAC Life (Years)	
Permanent	23
Relocatable	15
HVAC Cost	
Permanent	$1,667
Relocatable	$2,775
Roof Life (Years)	
Permanent	15
Relocatable	15
Roof Cost	
Permanent	$5,500
Relocatable	$3,500
Refurbishment	
Permanent 15 Yr.	$4,000
Relocatable 15 Yr.	$9,000
Relocatable Specific Costs	
Moving	$2,068
Connecting	$2,275
Detachment	$600
Avg. Annual Moves	0
Total Moving Costs	$0

F.D.O.E. Life Cycle Cost Analysis

Net Present Value	
Permanent	($105,919)
Relocatable	($105,655)

Annual Interest Payments	
Cost of Capital (Muni Rate)	7.00%
Inflation Rate	3.75%
Discount Rate	3.25%
Initial Capital Outlay	
Size (Sq. Ft.)	
Permanent	1,000
Relocatable	1,000
Structure Life (Years)	
Permanent	50
Relocatable	35
E.O.L. Value	
Permanent	40.00%
Relocatable	14.29%
Const. Cost (Sq. Ft.)	
Permanent	$61
Relocatable	$37
Lease	$0.0
Total Const. Cost	
Permanent	$61,000
Relocatable	$36,500
Lease	$0

Recurring Costs	
Annual Operating Cost	
KWH Permanent Sq. Ft.	10
KWH Relocatable Sq. Ft.	10
KWH Cost	$0.10
Permanent	$1,000
Relocatable	$1,000
Annual Maintenance Cost	
Permanent Sq. Ft.	$2.30
Relocatable Sq. Ft.	$2.30
Permanent	$2,300
Relocatable	$2,300
Replacement Costs HVAC Life (Years)	
Permanent	23
Relocatable	15
HVAC Cost	
Permanent	$1,667
Relocatable	$2,775
Roof Life (Years)	
Permanent	15
Relocatable	15
Roof Cost	
Permanent	$5,500
Relocatable	$3,500
Refurbishment	
Permanent 15 Yr.	$4,000
Relocatable 15 Yr.	$9,000
Relocatable Specific Costs	
Moving	$2,068
Connecting	$2,275
Detachment	$600
Avg. Annual Moves	0
Total Moving Costs	$0

F.D.O.E. Life Cycle Cost Analysis

Net Present Value	
Permanent	($110,640)
Relocatable	($110,412)

Annual Interest Payments	
Cost of Capital (Muni Rate)	6.50%
Inflation Rate	3.75%
Discount Rate	2.75%
Initial Capital Outlay	
Size (Sq. Ft.)	
Permanent	1,000
Relocatable	1,000
Structure Life (Years)	
Permanent	50
Relocatable	35
E.O.L. Value	
Permanent	40.00%
Relocatable	14.29%
Const. Cost (Sq. Ft.)	
Permanent	$61
Relocatable	$29
Lease	$0.0
Total Const. Cost	
Permanent	$61,000
Relocatable	$29,250
Lease	$0

Recurring Costs	
Annual Operating Cost	
KWH Permanent Sq. Ft.	10
KWH Relocatable Sq. Ft.	11
KWH Cost	$0.10
Permanent	$1,000
Relocatable	$1,100
Annual Maintenance Cost	
Permanent Sq. Ft.	$2.30
Relocatable Sq. Ft.	$2.50
Permanent	$2,300
Relocatable	$2,500
Replacement Costs HVAC Life (Years)	
Permanent	23
Relocatable	15
HVAC Cost	
Permanent	$1,667
Relocatable	$2,775
Roof Life (Years)	
Permanent	15
Relocatable	15
Roof Cost	
Permanent	$5,500
Relocatable	$3,500
Refurbishment	
Permanent 15 Yr.	$4,000
Relocatable 15 Yr.	$9,000
Relocatable Specific Costs	
Moving	$2,068
Connecting	$2,275
Detachment	$600
Avg. Annual Moves	0
Total Moving Costs	$0

F.D.O.E. Life Cycle Cost Analysis

Net Present Value	
Permanent	($105,919)
Relocatable	($105,779)

Annual Interest Payments	
Cost of Capital (Muni Rate)	7.00%
Inflation Rate	3.75%
Discount Rate	3.25%
Initial Capital Outlay	
Size (Sq. Ft.)	
Permanent	1,000
Relocatable	1,000
Structure Life (Years)	
Permanent	50
Relocatable	35
E.O.L. Value	
Permanent	40.00%
Relocatable	14.29%
Const. Cost (Sq. Ft.)	
Permanent	$61
Relocatable	$30
Lease	$0.0
Total Const. Cost	
Permanent	$61,000
Relocatable	$30,000
Lease	$0

Recurring Costs	
Annual Operating Cost	
KWH Permanent Sq. Ft.	10
KWH Relocatable Sq. Ft.	11
KWH Cost	$0.10
Permanent	$1,000
Relocatable	$1,100
Annual Maintenance Cost	
Permanent Sq. Ft.	$2.30
Relocatable Sq. Ft.	$2.50
Permanent	$2,300
Relocatable	$2,500
Replacement Costs HVAC Life (Years)	
Permanent	23
Relocatable	15
HVAC Cost	
Permanent	$1,667
Relocatable	$2,775
Roof Life (Years)	
Permanent	15
Relocatable	15
Roof Cost	
Permanent	$5,500
Relocatable	$3,500
Refurbishment	
Permanent 15 Yr.	$4,000
Relocatable 15 Yr.	$9,000
Relocatable Specific Costs	
Moving	$2,068
Connecting	$2,275
Detachment	$600
Avg. Annual Moves	0
Total Moving Costs	$0

F.D.O.E. Life Cycle Cost Analysis

Net Present Value	
Permanent	($110,640)
Relocatable	($110,609)

Lease Comparison

Annual Interest Payments	
Cost of Capital (Muni Rate)	6.50%
Inflation Rate	3.75%
Discount Rate	2.75%
Initial Capital Outlay	
Size (Sq. Ft.)	
Permanent	1,000
Relocatable	1,000
Structure Life (Years)	
Permanent	50
Relocatable	30
E.O.L. Value	
Permanent	40.00%
Relocatable	0.00%
Const. Cost (Sq. Ft.)	
Permanent	$61
Relocatable	$0
Lease	$4.4
Total Const. Cost	
Permanent	$61,000
Relocatable	$0
Lease	$4,350

Recurring Costs	
Annual Operating Cost	
KWH Permanent Sq. Ft.	10
KWH Relocatable Sq. Ft.	10
KWH Cost	$0.10
Permanent	$1,000
Relocatable	$1,000
Annual Maintenance Cost	
Permanent Sq. Ft.	$2.30
Relocatable Sq. Ft.	$0.00
Permanent	$2,300
Relocatable	$0
Replacement Costs	
HVAC Life (Years)	
Permanent	23
Relocatable	15
HVAC Cost	
Permanent	$1,667
Relocatable	$0
Roof Life (Years)	
Permanent	15
Relocatable	15
Roof Cost	
Permanent	$5,500
Relocatable	$0
Refurbishment	
Permanent 15 Yr.	$4,000
Relocatable 15 Yr.	$0
Relocatable Specific Costs	
Moving	$2,068
Connecting	$2,275
Detachment	$600
Avg. Annual Moves	0
Total Moving Costs	$0

F.D.O.E. Life Cycle Cost Analysis

Net Present Value	
Permanent	($110,640)
Relocatable	($110,609)

Lease Comparison

Annual Interest Payments	
Cost of Capital (Muni Rate)	6.50%
Inflation Rate	3.75%
Discount Rate	2.75%
Initial Capital Outlay	
Size (Sq. Ft.)	
Permanent	1,000
Relocatable	1,000
Structure Life (Years)	
Permanent	50
Relocatable	30
E.O.L. Value	
Permanent	40.00%
Relocatable	0.00%
Const. Cost (Sq. Ft.)	
Permanent	$61
Relocatable	$0
Lease	$4.3
Total Const. Cost	
Permanent	$61,000
Relocatable	$0
Lease	$4,250

Recurring Costs	
Annual Operating Cost	
KWH Permanent Sq. Ft.	10
KWH Relocatable Sq. Ft.	11
KWH Cost	$0.10
Permanent	$1,000
Relocatable	$1,100
Annual Maintenance Cost	
Permanent Sq. Ft.	$2.30
Relocatable Sq. Ft.	$0.00
Permanent	$2,300
Relocatable	$0
Replacement Costs	
HVAC Life (Years)	
Permanent	23
Relocatable	15
HVAC Cost	
Permanent	$1,667
Relocatable	$0
Roof Life (Years)	
Permanent	15
Relocatable	15
Roof Cost	
Permanent	$5,500
Relocatable	$0
Refurbishment	
Permanent 15 Yr.	$4,000
Relocatable 15 Yr.	$0
Relocatable Specific Costs	
Moving	$2,068
Connecting	$2,275
Detachment	$600
Avg. Annual Moves	0
Total Moving Costs	$0

F.D.O.E. Life Cycle Cost Analysis

Net Present Value	
Permanent	($110,640)
Relocatable	($110,609)

Lease Comparison

Annual Interest Payments	
Cost of Capital (Muni Rate)	6.50%
Inflation Rate	3.75%
Discount Rate	2.75%
Initial Capital Outlay	
Size (Sq. Ft.)	
Permanent	1,000
Relocatable	1,000
Structure Life (Years)	
Permanent	50
Relocatable	30
E.O.L. Value	
Permanent	40.00%
Relocatable	0.00%
Const. Cost (Sq. Ft.)	
Permanent	$61
Relocatable	$0
Lease	$4.2
Total Const. Cost	
Permanent	$61,000
Relocatable	$0
Lease	$4,150

Recurring Costs	
Annual Operating Cost	
KWH Permanent Sq. Ft.	10
KWH Relocatable Sq. Ft.	12
KWH Cost	$0.10
Permanent	$1,000
Relocatable	$1,200
Annual Maintenance Cost	
Permanent Sq. Ft.	$2.30
Relocatable Sq. Ft.	$0.00
Permanent	$2,300
Relocatable	$0
Replacement Costs HVAC Life (Years)	
Permanent	23
Relocatable	15
HVAC Cost	
Permanent	$1,667
Relocatable	$0
Roof Life (Years)	
Permanent	15
Relocatable	15
Roof Cost	
Permanent	$5,500
Relocatable	$0
Refurbishment	
Permanent 15 Yr.	$4,000
Relocatable 15 Yr.	$0
Relocatable Specific Costs	
Moving	$2,068
Connecting	$2,275
Detachment	$600
Avg. Annual Moves	0
Total Moving Costs	$0

Florida Department of Education
Frank T. Brogan, Commissioner

Affirmative action/equal opportunity employer